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ABSTRACT

This hearing before the Senate Committee on Health, Education, Labor, and Pensions on examining legislation authorizing funds for the Elementary Secondary Education Act, focusing on educational technology programs, contains statements by: James M Jeffords, Chairman, Committee on Health, Education, Labor, and Pensions; Barbara Means, Assistant Director, Center for Technology in Learning, SRI International, Menlo Park, California; Phil Hyjek, School Information Technology Specialist, Vermont Institute for Science, Math, and Technology, Waterbury Center; Patty Murray, Senator from Washington State; Jeff Bingaman, Senator from New Mexico; Ervin Duggan, President, Public Broadcasting Service (PBS), Alexandria, Virginia; Daniel Hogan, participant, PBS Mathline Program, Cincinnati, Ohio; Inabeth Miller, President, the Jason Foundation for Education, Waltham, Massachusetts, accompanied by Georgene Lytle, third grade teacher, Wooster, Ohio; Michael Pitroff, Project Director, Baltimore Learning Community, Baltimore, Maryland; and Carmen Gonzales, Director, Regional Educational Technology Assistance Project, New Mexico State University, Las Cruces, New Mexico. (MES)

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EDUCATION TECHNOLOGY

ED 442 471

HEARING

OF THE

COMMITTEE ON HEALTH, EDUCATION, LABOR, AND PENSIONS
UNITED STATES SENATE

ONE HUNDRED SIXTH CONGRESS

FIRST SESSION

ON

EXAMINING LEGISLATION AUTHORIZING FUNDS FOR THE ELEMENTARY SECONDARY EDUCATION ACT, FOCUSING ON EDUCATION TECHNOLOGY PROGRAMS

APRIL 22, 1999

Printed for the use of the Committee on Health, Education, Labor, and Pensions

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EDUCATION TECHNOLOGY

THURSDAY, APRIL 22, 1999

U.S. SENATE,
COMMITTEE ON HEALTH, EDUCATION, LABOR, AND PENSIONS,
Washington, DC.

The committee met, pursuant to notice, at 10:04 a.m., in Room SD–628, Dirksen Senate Office Building, Senator Jeffords [chairman of the committee] presiding.

Present: Senators Jeffords, DeWine, Bingaman, and Murray.

OPENING STATEMENT OF SENATOR JEFFORDS

The CHAIRMAN. The Health, Education, Labor, and Pensions Committee will come to order. We are looking forward to our hearing today.

In classrooms throughout the Nation, the next generation of learners are not looking at the blackboard for today's lesson but are looking into an electronic window on the world. Through this window, students can see the farthest reaches of the globe, seek to resolve real-world issues in real time and communicate their ideas to a global audience.

We all have high hopes that these technology-rich learning environments will encourage students to acquire the skills they need to live and work in the 21st century. And most of all, we hope, too, that such environments will not be limited to just the richest school districts. Nor can we presume that purchasing computers is the answer. Technical problems, inadequate professional training and lack of sustained funding may keep education technology from realizing its full potential.

The reauthorization of the Elementary and Secondary Education Act, ESEA, provides an excellent and important opportunity for the committee to explore the wide range of evolving educational technology. The Federal Government provides support for technology in education through several different programs. Among these initiatives are the Technology Literacy Challenge Fund and the Technology Innovation Challenge Grant, both authorized as components of Title III of ESEA. Resources from these programs and other sources have gone a long way in helping States and local governments launch technology-rich learning environments.

In my home State of Vermont, MIDI Distance Learning Project is supported in part by a Technology Innovation Grant. Through the use of special software, Vermont students compose original pieces of music and share their compositions with other students across the State. Teachers help students meet State and national standards for education, and professional composers around Vermont mentor teachers and students on-line. My mother, who was a music teacher, would be amazed. As we will soon here from another Vermont educator, when education technology works, it works well.

At the heart of these successful initiatives are teachers, who have not only learned the mechanics of using hardware and software, but have effectively developed lesson plans and integrated core curriculum into the technology-rich learning environment. Technology by itself will not improve student learning, but it can be a useful tool.

Our 21st century teachers, most of whom in the near term will be products of the 20th century, need support and meaningful professional development to put this tool to its highest and best use.

Our teachers are not the only ones who must be prepared. Our students must be prepared to join a workforce that requires more than mastery of Mario, MineSweeper or Mortal Kombat, but demands problem-solving skills and a deeper understanding of how computers work. Through the reauthorization process we have an opportunity to ensure that ESEA programs help our students develop real-world skills for the workforce to which they will graduate.

Finally, we need to encourage strong partnerships among teachers, students, parents, education professionals, community and industry critical to the success of many ESEA programs. By working together to provide resources, context and support, we can build technology-rich education environments of the next century.

Today we are fortunate to have appearing before us individuals whose broad experiences will enlighten the committee about the effectiveness of technology in education. Do Title III programs complement or conflict with local, State and other Federal efforts to support education technology? Do we need to look beyond the programs themselves and encourage better overall coordination of Federal education technology programs? We also need to develop the means to evaluate the effectiveness of various programs and methodologies.

What we hope to gain from this exchange today is a better understanding of what policymakers can do to strengthen programs now underway and to encourage new ones. I am looking forward to hearing from our witnesses.

Our first witness is Dr. Barbara Means, the assistant director of the assessment and evaluation programs for the Center for Technology in Learning at SRA International. She has directed numerous research projects concerned with technology strategies for addressing critical issues in school reform. Her current projects include studies of technology use in urban high schools and of a worldwide network environmental project.

We are delighted that Dr. Means could join us today to share her experience and perspectives on educational technology. Why don't you proceed, Dr. Means, and then I will introduce our second member of the panel?

STATEMENT OF BARBARA MEANS, ASSISTANT DIRECTOR, CENTER FOR TECHNOLOGY IN LEARNING, SRI INTERNATIONAL, MENLO PARK, CA; AND PHIL HYJEK, SCHOOL INFORMATION TECHNOLOGY SPECIALIST, VERMONT INSTITUTE FOR SCIENCE, MATH, AND TECHNOLOGY, WATERBURY CENTER, VT

Ms. MEANS. Thank you, Mr. Chairman. Thank you for the opportunity to express my views concerning technology in education.

While the technology infrastructure in America's schools has grown dramatically, schools serving low-income students lag behind those serving the more affluent in terms of the student-computer ratio and the proportion of classrooms with Internet connections. Moreover, even when technology access is equivalent, inequities exist because the ways in which technology is typically used in schools serving different kinds of students varies markedly.

In schools serving mostly middle class students, there is an emphasis on teaching students to think and create with technology rather than on simply learning from technology. Instruction for middle class students is geared toward putting the students in control; for example, by preparing on-line reports or exploring simulations. That, for low income students, is more likely to put the technology in control through uses such as delivering information or basic skills practice sessions.

Federal compensatory education programs have had mixed effects with respect to equity. On the one hand, an estimated $2 billion of Title I funds has supported educational technology within schools serving low income students over the last decade. On the other hand, Title I dollars going to technology at the local level tend to be used for drill and practice in basic skills.

I would like to raise several points for your consideration during reauthorization. One, flexibility in use of Titles I, II and III funds for technology-related supports and teacher professional development is important to schools serving low income students. These funds have paid for software, teacher professional development and badly needed technical support. Without these programs, schools serving low income students would have little chance of bridging the digital divide.

Two, emphasis on multiple choice testing of discrete basic skills and broad factual knowledge often has a chilling effect on innovative uses of technology, particularly in schools serving low income students. Those schools are most likely to be in a "Do well on the test or get taken over" situation, and teachers feel they cannot afford to spend significant time on technology-using projects.

Schools should be pressed to demonstrate that they are not raising scores on tests of basic skills at the expense of giving students the opportunity to learn the advanced skills of planning, research, data analysis and composition.

Title I tries to encourage this balance by calling for instruction in both basic and advanced skills, but obtaining equal emphasis on the latter requires placing equal emphasis on assessing those advanced skills.

Third, teacher preparation and support are key, as you have mentioned. When you move away from canned programs that do the teaching to flexible uses of technology tools, the teacher's role as activity designer, classroom facilitator and learning evaluator is critical. While we need to do a better job in preservice education, we also need to find better mechanisms to support today's teachers, only 20 percent of whom feel prepared to use technology for instruction.

Our studies of schools that have been more and less successful in getting a significant proportion of their teachers to use technology suggest that on-going professional development, including informal as well as formal supported activity, is far superior to one-shot training sessions. Title III-funded projects often support such on-going activities.

We find also that most teachers will get serious about using technology in their classrooms only if they see ways in which it will support learning in the subject matter domain for which they are responsible. A policy implication is that teacher professional development in technology use and that in subject-specific content and teaching strategies should be combined rather than separate.

My fourth point, leadership and support from the principal are vital. Principals are critical in setting expectations with respect to technology use, locating technology resources, and making it possible for teachers to receive the professional development and planning time they need to integrate technology with instruction.

Finally, existing Title III programs are not the right vehicle either for answering basic research questions concerning how best to use technology to foster various types of learning or for solving the problem of a scarcity of high quality software in subject areas beyond basic skills.

The PCAST report made the case for the importance of these activities and the need for Federal leadership. Grants to States and LEAs are unlikely to yield a body of systematic research findings or an optimal software inventory.

In summary, I favor continued use of Titles I, II, and III programs as supports for technology in low income schools. The tendency to limit technology activities for Title I students to drill and practice can be mitigated by first, placing greater emphasis on testing advanced skills of these students and second, increasing the focus of Title III programs on schools serving low income students.

The CHAIRMAN. Thank you, Doctor.

[The prepared statement of Ms. Means follows:]

PREPARED STATEMENT OF BARBARA MEANS

Mr. Chairman and members of the committee, thank you for this opportunity to express my views concerning technology and education.

While legislation typically deals with aspects of education one by one, the pieces come together at the school level, where policies and funding streams interact with local variables to influence teacher behavior and student experiences. On the basis of a decade spent researching educational technology use in schools serving students from low-income backgrounds, I would like to offer some observations on the conjoint impact of ESEA Titles I, II, and III on equitable access to learning with technology.

The technology infrastructure in America's schools has grown dramatically over the last two decades. In 1984 there was an estimated one computer for every 50 students; by 1998 there was one for every 6.[1] Equally important, there has been significant improvement in the presence of computers in schools serving low-income students.[2]

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[1] Mageau, T. Computer Using Teachers, Agenda, 1, 51, 1991; and Education Week, Technology Counts '98. Washington, DC: Education Week and the Milken Exchange on Education Technology, October 1, 1998.

At the same time, the majority of schools still do not have enough computers to support frequent use by all or most students. When only computers in regular classrooms are counted, there were 17 students per computer in 1998.[3] Moreover, schools serving low-income students lag behind those serving the more affluent in terms of the student: computer ratio and the proportion of classrooms with Internet connections. Only 39% of classrooms in the poorest schools had an Internet connection in 1998, compared with 63% of classrooms in the wealthiest schools.[4] We still have a long way to go to provide equal and adequate access. Moreover, even when technology access is equivalent, inequities exist because the ways in which technology is used in schools serving different kinds of students vary markedly.

In schools serving mostly middle-class students, there is an emphasis on teaching students to think and create with technology rather than on simply learning from technology. Instruction for middle-class students is geared toward putting the students in control, while that for low-income students is more likely to put the technology in control (through uses such as delivering information or basic skills practice sessions).

The student-controlled activities more typical in middle-class schools include having students:

- gather and analyze information,
- produce on-line reports and multimedia presentations of their research findings,
- manipulate computer models and simulations (or even produce their own models) as they develop and refine their understanding of systems and concepts, and—interact with distant scientists as they participate in real scientific expeditions and investigations.

Such programs foreshadow the environments that knowledge workers will encounter in the next century and can be powerful contexts for learning. Some examples:

- Middle school students in classrooms using the inquiry-oriented ThinkerTools software manipulate simulations and visualizations of the concepts of velocity and acceleration. In carefully controlled studies, these middle schoolers have outperformed high school physics students in their ability to apply physics principles to real-world situations.[5]

- Knowledge Forum, a networked database for learning, has been used in subject areas including science, history, and social studies. Students create text and graphics "notes" about the subject under study, labeling their contributions in terms of the kind of thinking represented-for example, "my theory for now" or "what we need to learn about next . . . ." Other students can search and comment on these notes. With teacher support, dialogues among students and an accumulation of knowledge emerge. Students using this software have performed better than students in control classes in terms of standardized tests, portfolio entries, and rated depth of explanations.[6]

- In the GLOBE program, elementary and secondary school students learn science by following scientific data collection protocols for measuring characteristics of their local atmosphere, soil, and vegetation. Thousands of students are using GLOBE Web-based data entry forms to submit data to a central archive used by both students and scientists. Students in active GLOBE classes have performed better than their age-mates in other science classes on assessments, not only of their ability to take the kinds of measurements used in GLOBE, but also of knowledge of sampling and measurement principles and ability to interpret data and apply science concepts.[7]

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[2] In 1994-95, for example, schools serving the largest proportion of Title I students had one computer for every II students, compared with one computer for every 9.5 students in schools serving the smallest proportion of Title I students (PCAST, Report to the President on the Use of Technology to Strengthen K–12 Education in the United States. Panel on Educational Technology, 1997).

[3] Technology Counts '98. Washington, DC: Education Week and the Milken Exchange on Education Technology, October 1, 1998.

[4] NCES (National Center for Education Statistics). Advanced Telecommunications in U.S. Public Elementary and Secondary Schools, Fall 1996, 1997, and Internet Access in Public Schools, Issue Brief, February 1998.

[5] White, B. Y., & Frederiksen, J. R. Inquiry, Modeling, and Metacognition: Making Science Accessible to All Students. Cognition and Science, 16: 90-91, 1998.

[6] Scardamalia, M., & Bereiter, C. Engaging Students in a Knowledge Society. Educational Leadership, 54(3), 6-10, 1996.

[7] Means, B., & Coleman, E. Technology Supports for Student Participation in Science Investigations. To appear in M. J. Jacobson & R. B. Kozma (Eds.), Learning the Sciences of the 21st

Continued

Although we have many more examples of such programs today than we did ten years ago, and several representatives of noteworthy projects are here today, they are still far from the norm in U.S. schools. A recent national survey of 4,100 teachers found that in 1998, only 6% of teachers had their students work with other students at a distance in cross-classroom projects; only 4% had students "publish" the results of their work on the Web.[8]

Federal compensatory education programs have had mixed effects with respect to equity. On the one hand, an estimated $2 billion of Title I funds has supported educational technology within schools serving low-income students over the last decade.[9] On the other hand, Title I dollars going to technology at the local level tend to be used for drill and practice in basic skills.

Survey data collected as part of the 1996 National Assessment of Educational Progress (NAEP) in eighth-grade mathematics, for example, indicate that drill and practice programs were used more commonly with African American, Latino, and Title I students, while simulations and application programs (which were associated with higher mathematics scores) were more commonly used with non-poor, suburban, and white and Asian students.[10]

I would like to raise several points for your consideration:

1. Flexibility in use of Title 1, Title 11, and Title III funds for technology-related supports and teacher professional development is important to schools serving low-income students. These funds have paid for software, teacher professional development, and badly needed technical support. Without these programs, schools serving low-income students would have little chance of bridging the "digital divide." The easing of constraints on schoolwide Title I programs has been a plus for efforts to integrate technology with whole-school improvement; I would like to see this policy continued.

2. Emphasis on testing broad factual knowledge through multiple-choice test results is having a chilling effect on innovative uses of technology, particularly in schools serving low-income students. Those schools are most likely to be in a "do well on the test or get taken over" situation, and teachers feel they cannot afford to spend significant time on technology-using projects. Schools should be pressed to demonstrate that they are not raising scores on tests of basic skills at the expense of giving students the opportunity to learn the higher-order skills of planning, research, data analysis, and composition-areas that employers say will be critical for competition in the economy of the next century.[11] Title I tries to encourage this balance by calling for instruction in both basic and advanced skills. But obtaining equal emphasis on the latter requires assessments that cover advanced as well as basic skills.

Widely used assessments do a better job capturing basic skills than they do on more advanced skills. The creation and validation of assessments of complex, advanced skills is technically challenging and expensive. While some states are taking up this challenge, they would be well served by federally supported R&D in this area, including the development of assessments of advanced skills (such as data analysis) that can be supported by technology. The use of a balanced set of assessments of both basic and higher-order skills in schools serving students from low-income backgrounds would stimulate more balanced uses of educational technology. It should be noted that technology can contribute to ameliorating this problem, for example, by creating centralized on-line banks of advanced-skills assessment items that districts and states can turn to for pre-tested items (as in the National Science Foundation-funded Performance Assessment Links in Science available at http://www.tappedin.sri.com/pals/).

3. Teacher preparation and support is key. When you move away from canned programs that do the teaching to flexible uses of technology tools, the teacher's role-as activity designer, classroom facilitator, and learning evaluator is critical. We

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Century: Theory, Research, and the Design of Advanced Technology Learning Environments. Mahwah, NJ: Erlbaum.

[8] Becker, T. J. Internet Use by Teachers: Conditions of Professional Use and Teacher-Directed Student Use. Irvine, CA: Center for Research on Information Technology and Organizations, University of California, Irvine, and University of Minnesota, 1999.

[9] PCAST (President's Committee of Advisors on Science and Technology). Report to the President on the Use of Technology to Strengthen K–12 Education in the United States. Panel on Educational Technology, 1997.

[10] Wenglinsky H. Does It Compute? The Relationship between Educational Technology and Student Achievement in Mathematics. Princeton, NJ: Educational Testing Service, 1998; and CEO Forum, School Technology and Readiness Report, Year Two. Professional Development: A Link to Better Learning, February 22, 1999.

[11] SCANS (Secretary's Commission on Achieving Necessary Skills). What Work Requires of Schools. Department of Labor, 1991.

must prepare teachers not just to be technology users themselves but, more importantly, to orchestrate powerful learning activities that include student use of technology tools where those tools enhance learning. While we need to do a better job in preservice education for the 2 million who will join the teaching force by the year 2010 (as recognized by the Preparing Tomorrow's Teachers to Use Technology initiative), we also need to find better mechanisms to support today's teachers, only 20% of whom feel prepared to use technology for instruction.[12]

Our studies of schools that have been more and less successful in getting a significant proportion of their teachers to use technology in instruction suggest that ongoing professional development, including both informal and formal, supported activities, is far superior to one-shot training sessions.[13]

The most powerful teacher learning in educational technology occurs when teachers are involved in an active network of like-minded teachers. When such support networks emerge within schools, teacher technology use is likely to be more widespread and sustained. Support networks can also emerge across schools or between teachers and content experts and educational technology researchers. TAPPED IN, the on-line teacher professional development environment run by SRI, offers one approach for supporting such networks.

More than 3,200 education professionals allied with one or more educational improvement efforts are communicating with distant colleagues, sharing Web sites and other documents, and collaboratively developing learning experiences in TAPPED IN's electronic "spaces." (See http://www.tappedin.org.)

We find also that most teachers will get serious about using technology in their classrooms only if they see ways in which it will support learning in the subject matter domain for which they are responsible. A policy implication of this finding is that teacher professional development programs in technology use and those in subject-specific content and teaching strategies should be combined rather than separate. This means, for example, training teachers in the use of Web resources or specific software for teaching biology as part of efforts to improve biology teaching rather than simply training them on general Internet use skills.

4. Leadership and support from the principal are vital. Principals are critical in setting expectations with respect to technology use, locating technology resources, and making it possible for teachers to receive the professional development and planning time they need to develop and implement technology-supported instruction. Many principals feel ill prepared for this role and do not receive professional development in this area.

5. Existing Title Ill programs provide resources and a catalyst for partnerships and innovation. The competitive nature of these programs encourages schools to examine how technology can help meet their educational goals and to enter into partnerships through which they can obtain both financial and intellectual resources from external organizations. In contrast to typical Title 1-funded activities, Title III programs support innovations aimed at fostering higher-order skills. It is true that many schools serving low-income students lack the leadership and vision needed to compete for such funding, particularly at the federal level. Nevertheless, simply distributing technology funds on the basis of enrollment of students from low-income backgrounds would be unlikely to produce meaningful changes in schools in the absence of leadership and a compelling vision.

6. Existing Title Ill programs are not good vehicles either for answering basic research questions concerning how best to use technology to foster various types of learning or for solving the problem of a scarcity of high-quality software in subject areas beyond basic skills. The PCAST Report (1997) makes the case that research on the most effective ways to use technology to foster different kinds of learning is sorely needed, as is the development of research-based, high-quality software products.[14] Given the fragmentation of the school market and the low likelihood that a major investment in research could be recovered, the private sector is unlikely to fill these needs. The primary recipients of Title III funds-states, LEAs, and schools-do not have the mission or the expertise to fill these roles. Federal leadership and funding for a systematic research agenda are needed.

In summary, very real progress has been made in bringing technology to America's schools, but concerns remain regarding equity and teacher preparation and support. We need to continue to encourage both whole-school improvement efforts and high-quality multi-site projects in specific subject areas that integrate appropriate technology use with challenging academic content. At the same time, to make the best use of technology capabilities in education, there is a need for federal leadership in supporting research and development on balanced assessments that include measurement of the planning, research, data analysis, and composition skills that students will need in the 21st century.

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[12] NCES (National Center for Education Statistics). Teacher Quality: A Report on the Preparation and Qualifications of Public School Teachers, January 1999.

[13] See Means, B., & Golan, S. Transforming Teaching and Learning with Multimedia Technology. Menlo Park, CA: SRI International, October 1998, and Means, B., & Olson, K. Technology's Role in Education Reform: Findings from a National Study of Innovating Schools. Menlo Park, CA: SRI International, 1995.

[14] PCAST, 1997.

The CHAIRMAN. We are also pleased to have with us Mr. Phil Hyjek before the committee. As a school information technology specialist in the Vermont Institute for Science, Math and Technology, VISMT, Mr. Hyjek is responsible for the coordination of the State-wide School Technology Plan in Vermont. In his position, he has helped to bring together a variety of funding sources, such as the Technology Literacy Challenge Grant Fund, E-rate discounts and other resources to support Vermont's education technology plan. Thanks for coming.

Mr. HYJEK. Thank you, Senator. I appreciate the opportunity to testify here today. I think I am going to be presenting the opposite end of the spectrum from Dr. Means in terms of how some of these programs work in a small State, and I think it is, in fact, very different.

My focus today is going to be on the Technology Literacy Challenge Fund, the piece that I primarily work with, and I would like to talk to you about the impact that that program has had on our State.

The senator mentioned in his opening comments also a project we refer to as the Web Project, which is funded through a Technology Innovation Grant, but my focus is going to be much more on the Literacy Challenge Fund, where we focus on the at-need schools.

Our sense is that the TLCF program has really provided us with incentive and support to sustain standards-based systemic school improvement, which is something that Vermont has been highly involved with for the past few years.

In fiscal 1997, Vermont received $1 million from TLCF and $2,125,000 in both fiscal 1998 and 1999. Again I think in a State like California, that would seem to be a very small amount of money. However, in Vermont it actually goes a very long way and we are very grateful for it.

Ninety-five percent of those funds were distributed to schools through competitive grants, specifically targeting schools with significant levels of poverty and technological need. At that time, 10 percent of our schools had developed technology plans, so the pool of eligible applicants was severely limited, remembering that you needed to have an approved technology plan to apply for TLCF funds.

What we found was that in some cases, grants went to schools that were already positioned to apply for the funding. They had made substantial investments in technology. So we saw a real technology gap that already existed potentially getting wider because the support was not there for the at-need schools.

We decided at that time to make a real focussed effort to develop the capacity in the under-resourced schools. There was a paradox there in the sense that those schools also had the least ability to effectively use the grant resources. Teachers and students in these schools had no context for the instructional potential that was provided through fast, new generation computers or high-speed Internet access.

The TLCF grants provided the incentive for us to promote serious technology planning at the local level. However, we felt that the availability of the financial resources to invest in technology would not, by itself, contribute to the systemic change agenda. We wanted technology to be deeply imbedded in the classroom experience. We wanted teaching and learning to be infused with technology. We set high standards for technology planning, requiring schools to address not just hardware and software, networking or connectivity, but to focus on the true purpose of schools: teaching and learning.

Schools had to think through how they were going to increase their capacity, have financial sustainability, professional development and technical support. They had to correlate their plans to our State plan and, most importantly, they had to address how they would use technology as a tool to support Vermont's framework of standards and ultimately to increase student performance.

In order to accomplish our goal to promote effective planning, we conducted regional workshops, we met with school planning teams, we provided individual consultations to most of Vermont's schools districts. And again we are a small State. We are able to do those kinds of things.

Through our outreach efforts, 92 percent of Vermont's schools have approved multiyear technology plans as I speak. The TLCF resources have made a real difference in the schools that are most in need.

In fiscal year 1997 when TLCF funds were just becoming available, 95 percent of Vermont's schools had access to the Internet. That appears to be good news. Closer examination shows that only 20 percent of those schools had direct connections and that those connections were available in the school library or in the principal's office. A year later, 72 percent of our schools had connectivity at the classroom level.

Although our most recent data is not yet available, we expect that almost all schools will have local area networks and high speed dedicated connections to the Internet by the end of the fiscal year.

We leveraged a fair amount of E-rate funding, combined with TLCF, over $2 million in E-rate discounts from this last cycle. And what we found is that almost all of that money is being reinvested by school districts, not to reduce tax rates, not to reinvest in some other part of the general fund, but back into technology—to buy better hardware, to buy more training, to buy more connectivity. So it is not just the TLCF dollars; it is also the combination of what is happening with E-rate.

Like many States, Vermont has not been able to provide large State appropriation for educational technology. Only the wealthier school districts have been able to make substantial local expenditures in this area. The Technology Literacy Challenge Fund has had a major impact on Vermont's schools by creating the incentive for systematic planning and creating equity of access for students in those targeted schools.

Of course, hardware, software and connectivity are only a piece of this extremely complex equation. These are only tools. They are expensive tools, but they are only tools. Obviously these tools alone will not improve teaching and learning. Title III's intent was to not only increase access to technology but also to integrate technology into curriculum and increase teacher capacity to utilize that technology in their instruction.

Although sometimes it appears that there is an almost insatiable need for faster hardware and increased bandwidth, we know our efforts must focus on the need for professional development that will increase the teacher skills and their ability to use the technology in their instruction. In order to address this, we established a State-wide organization, Vermont Information Technology Association for the Advancement of Learning, for the purpose of promoting, developing and delivering State-wide and regional professional development. Although this is a newly formed organization, VITA-Learn has already provided professional development, and when I say professional development in this sense I mean in the sense of technology, basic schools, standards-based unit integration, to 20 percent of the teacher workforce, and that is in just a little over 18 months.

Again we realize this is only a beginning. Creating substantive change takes a great deal of time, but during the last TLCF competition, we made a policy decision to have subgrantees use 25 percent of their annual award in professional development and we required them to provide us with a multiyear professional development plan. Again we are looking at how do we grow capacity?

I agree with the comments that you made about very often we have one-time professional development opportunities, and we have done a certain amount of that. We felt we needed to do that and if teachers are at that point, they need to have those opportunities.

The next step in our phase is to get inside the classroom. We are beginning to look at how do we set up mentorships and modeling to be able to take that 25 percent of the award and have professional development activities that are inside the classroom so that teachers can have that kind of modeling, not just the one-shot deal but the on-going support.

To further the change—I guess this is possibly the only recommendation that I have for you in terms of the reauthorization—to further the change, I would like to ask you to take a leadership role in providing additional financial resources to States that are committed to bottom line education, and I think Vermont is. We are looking at student performance assessment. We are looking at a number of different kinds of assessment protocols and we are very serious about this.

But to be able to do the kind of analysis on student performance, we desperately need a State-wide network that can support data analysis to the student level, that will allow teachers to look at how well they are doing, how well students are doing, to look at schools, to look at the State overall. And again I think that is the kind of information that we need. It is not direct instruction as far as the use of technology and really something that we feel lies outside of TLCF, but something we think that the Federal Government can help us a great deal with and that this ultimately provides the impetus to drive educational change.

Finally, we believe that the support that has been provided to our school districts through TLCF has been invaluable and we urge you to continue the funding for this program. Thank you, Senator.

The CHAIRMAN. Well, thank you very much.

I am extremely interested in what this can do for us in education, so I am going to be asking a number of questions along those lines.

If you were to give education technology a report card, where could we make the greatest improvement? In your view, how effective is technology in education and how effective have the current Title III programs been? We will start with Dr. Means.

Ms. MEANS. It is always hard to boil things down to a single number or grade. Despite my concerns about equity and where we have not yet gone, I think I would have to give educational technology and Title III in this regard at least a B, which is pretty good.

And the reason for that is there has been a transformation in classrooms in the United States over the last decade. The number of classrooms that are actively using the Internet, the number of teachers which are becoming aware of new teaching strategies and exciting programs, such as some of those you will hear about in the next panel, is definitely on the rise and I think we have made quite a bit of progress, which is not to say we do not have significant work left to do.

And I think that connection which Mr. Hyjek mentioned between assessment activities, such as the performance assessment happening in Vermont, and being able to connect that with our technology activities and our goals for learning is really the critical piece we need to work on.

The CHAIRMAN. Mr. Hyjek?

Mr. HYJEK. I think as far as Title III's intent and the funds that we have had, the intent is right. The implementation is a State's responsibility. I think it is up to us, if you provide us with the resources, it is really up to us to make sure that those resources are used appropriately. We have to put the effort into working with the teachers to find those avenues to make this make sense as far as why they need to use these things in the classroom.

Certainly we are at a point in Vermont where we are going to see a fair amount of our teacher workforce turn over in the near future, so we have a dilemma in terms of some of our teacher workforce who are not really interested in developing the technology skills because they are going to be leaving the classroom fairly shortly.

However, on the other side, working with our higher ed partners and making sure that the students who are coming into the classroom directly out of college have those skills and are able to use that appropriately is important.

There was a recent study done at ETS that indicated that at least at the fourth grade level, the use of technology was very effective in terms of increasing basic skills. Vermont scored very well in that. We are seeing that in the classroom. I think that our implementation is actually much more effective at the elementary level right now than it is at the high school level.

In the math and science areas, especially in the science areas, there seems to be a natural connection. We are trying to broaden that. The Web Project, we have the Millennium Arts Project where we are trying to now get the humanities also involved.

But we have to continue to monitor. I think right now the evidence that we have is anecdotal. We have the reports from the teachers, from the principals, from the school boards in terms of telling us what they think is working.

Ultimately we have to get to the point where we are also trying to make the correlation between what is happening in the school with technology and the investment in technology and student outcome. Unfortunately, we are a ways away from that, Senator, but I think that is our goal.

The CHAIRMAN. That is what I am concerned about in what we should be doing in the reauthorization. How do we enhance the ability of teachers, principals, whatever, to know what programs work and what programs don't. There does not seem to be any, that I have run into, coordinated evaluation of programs to provide guidance on what works, what does not work.

I see heads going up and down, so I assume that that is a problem, but I would like your comments on that. What should we do nationally to try to get some ways to evaluate the success of these programs, as well as what kind of teacher training is successful and the overall utilization in the schools? Any thoughts?

Ms. MEANS. I think you have to look at the evolution of these programs, which started with the Technology Innovation Challenge Grants. These are grants which are heavily competed for and which must be led by local education agencies, and naturally their first mission is the improvement of education in the jurisdiction for which they are responsible. They are not primarily research agencies and their responsibility is a local one, rather than a national one.

What I would urge thinking about would be differentiation of the Technology Innovation Challenge Grants and the Technology Literacy Challenge Fund, where the latter is under the control of the States and is focussed on improving individual school districts or States and is more applied, pragmatic in approach, and I think the Federal funds, quite properly, should be used for developing, demonstrating, researching and propagating models, and they should have a much heavier research obligation and they should be leading toward the formulation of models in different content areas. This is what model technology-supported instruction looks like in algebra. This is what it looks like in Biology 1. And that should be a differentiation between the two programs in terms of mission. I think that would help to solve part of this problem.

And I think the other part is to have a federally supported research agenda trying to answer some of these questions as research questions. What happens now is every program has a huge mix of elements to it, a huge mix of local variables. Each one is different. So even when we see good effects, we have a very hard time attributing that to one variable or another, and it really takes a program aimed at researching these questions to be able to address that need, and we have not had it.

Mr. HYJEK. A couple of comments. I think we are lucky in Vermont that we have a relationship with NSF. VISMT, the organization where I work, although my position is actually a State Department of Education position, is charged with improving instruction in math, science and technology, although the main focus is on the math and science piece.

To support standards-based instruction, we have some people on our staff who, in fact, look at all curricular materials that are available and make recommendations, consult to schools who are looking to adopt a new math program or a new science program, work with them in terms of a K-12 continuum.

A fairly recent part of that is also to look at the software that very often is related to those programs and, in fact, does that support standards-based instruction? Does it enhance? Does it, in fact, do what publishers are making as claims? In some cases we find those things are true and in some cases, not. But I think that is a piece that is going to help us as far as helping teachers, helping school districts select appropriate software.

The main focus for us, though, in the planning and in the proposal development of schools is to encourage schools to invest in basic productivity tools, not a lot of the really glitzy kinds of software that is out there that necessarily is the kind of thing that my daughter, who is nine, would really enjoy at home and may have some value. We are looking for schools to use office suites that have spreadsheet, word processing, database applications. We are looking for them to have students understand how to use a browser, to access the Internet, to access information. The idea of really being able to access information, to analyze that information, to synthesize that and to create a new product, to give a report, possibly put it into some kind of multimedia presentation and report that back, so that they can show what they have learned.

Our sense is that that is really where the use of the technology enhances education. It is not the matter of let's plug some kids into a computer over here and let them play Math Blaster or whatever. Although that may help with increasing some multiplication skills, what we are really looking for is a much deeper integration.

And again I think that is a function of our responsibility in terms of at the policy level, helping districts as they plan and as we certify those plans, to look at what they are thinking about and the directions they are moving and guiding them in that direction.

Again the evaluation piece, I have some projects right now where we have some schools that are, in fact, starting to look at their baseline data over a period of time, whether they are looking at standardized tests or standards-based tests or, in some cases, their own teacher-made tests, looking at what has happened since they have acquired technology, how they have used the technology and, in fact, are students gaining in the kinds of skills that we want them to gain?

The early evidence says to me that, in fact, that is happening and it is happening, though, only in cases where the teachers have had the appropriate training and have the interest to really be able to use the technology effectively.

I think that probably ties together with the performance report. We have just finished the first TLCF performance report. And again, although that is fairly anecdotal—we are not looking at student performance data—I have a sense that as time goes on, we are going to be looking at more and more student performance data as we look at the effectiveness of the resources that were invested.

The CHAIRMAN. Do you get any guidance in this respect from the Department of Education?

Mr. HYJEK. Did we get guidance? Yes, we got a lot of guidance. The program officers were excellent.

The CHAIRMAN. You are talking about Federal or State?

Mr. HYJEK. At the Federal level.

The CHAIRMAN. Dr. Means.

Ms. MEANS. I wanted to make the point that what often happens with these individual grants, the individual challenge grants, is that there is only a loose connection between the nature of the activities supported by the grant and a lot of the student outcome measures that we currently have.

For example, one of the Technology Innovation Challenge Grants that we are evaluating, the schools are, in fact, seeing an increase in some of their standardized test scores in the reading area. However, when you look at the 35 schools involved in the program and the proportion of classrooms that are implementing the Innovation Challenge Grant, it is very hard to make a causal connection from this and in order to evaluate the program, we, in fact, needed to develop measures of student performance that were much more tightly coupled with the experience that they get in the classroom supported by the challenge grant.

That is an expensive and technically challenging effort, but it is part of any evaluation that is going to answer the question about the impact of this particular technology program. And I think too often we are looking at scores on tests that have almost nothing to do with the activities that we actually supported with the Title III funds. And this mismatch is leading us to a lot of assumptions that really are not well founded.

The CHAIRMAN. Further comment on that?

Mr. HYJEK. No. Good point.

The CHAIRMAN. You agree with what she said? OK.

Senator Murray, it is a pleasure to have you here.

[The prepared statement of Senator Murray follows:]

PREPARED STATEMENT OF SENATOR MURRAY

Thank you, Mr. Chairman. I'd like to thank you, Senator Kennedy, Senator Bingaman, and the other members of the committee for a long-standing commitment to improving school and community access to educational technology.

As you know, my own work in this area has included several efforts. I have fought for expanded funding for education technology and for teacher technology training on the Appropriations Committee. In this committee last year, with your help, we were able to take the first step in improving teacher preparation in technology under the Higher Education Act.

This year, it is my hope that we can pass the second and more comprehensive part of my Teacher Technology Training Act, by including technology as part of professional development in school district training activities under reauthorization of ESEA.

In addition, I have been supportive of the e-rate, as have many of us here. I have passed legislation to improve access to current-generation surplus technology, and I have fought to increase appropriations for Star Schools and the PBS programs, and of course the major programs that the Department runs, from the Literacy Fund to the Challenge Grants to the regional centers.

I have appropriated funds for technology projects directed at adult and family literacy, and I have worked with local partners in my State to help schools improve technology through partnerships with businesses and others.

I think my support of educational technology is fairly clear.

But we must all remember that technology is a learning tool, a vehicle for improved learning. I have seen some amazing things done with technology, that lead to improved engagement by students, in an increase in National Merit Scholars, and the like. But these anecdotal successes will not support us over the long-term.

If you are an advocate for education technology, as I am, you have to look seriously at the threats to our investment.

One threat would be that we don't clearly demonstrate for all to see that technology does improve learning. Or that we don't adequately help educators get all students learning "higher order" skills with technology.

Another threat would be that we allow technology disparities to continue, ultimately creating an "information underclass" of people who don't have access to meaningful employment.

Another would be willy-nilly spending on technology, divorced from planning for improved student achievement.

Or that the great partnerships between schools and businesses that are springing UP around the Nation would somehow suffer a setback.

Another would be local firestorms over content that cause people to pull technology out of their schools.

Perhaps the most serious would be that the Congress, which has taken such a major role, would slow down it's own progress or support. We have invested in America's schools moving forward with acquisition of hardware, software and capacity for connectivity, for training and technical support. We have tried to do so in a way that invested in access for the neediest schools and communities, and that invested in innovation—in finding out how to do things well and then replicate that knowledge for all schools to see.

I mention these threats because I think education technology really does make a measurable difference. I think most of the members of this committee and this Congress and the American public agree with me. We all believe that we don't want to create "haves" and "have-nots" when it comes to technology.

Today's economy will not allow us to waste any potential workers or entrepreneurs. Everyone needs to be better equipped, and everyone needs to know how to work the tools of the new workplace.

So we need to continue moving ahead, and directly taking on the threats to our national progress. We need to learn from the successes of the people we will hear from today, and not forget the larger issues as we move forward this year with reauthorization of ESEA.

Thank you.

Senator MURRAY. Thank you, Mr. Chairman, and thank you to both of you. I appreciate your having this hearing. It is a difficult morning. There are a number of hearings going on and I know of many senators who would like to be here for this and I wanted to at least come by for a portion of it because I think education technology is an extremely important discussion area and I want to thank the chairman and Senator Kennedy and Senator Bingaman, who worked very hard on this. It is a wide topic. It is not a very simple topic and there is a lot before us.

I have long been an advocate of education technology. I have seen in classrooms what a difference it can make for young students. I know the challenges that are out there. I have worked hard here as a senator to get computers into classrooms and to work on teacher training. In fact, we passed my amendment last year on the Higher Education Act so that teachers would get training. I hope under the reauthorization of ESEA we can make sure that teachers who are in the classrooms will get the training they need because it does not do any good to put a computer in a classroom if the teacher does not know how to use it.

I think challenge grants, all of these things are great but I think there are a couple of challenges out there that I would like to explore with you. The first one really is what I just referred to, which is putting technology into classrooms, very expensive equipment. It often has to be updated constantly. It can be extremely expensive to a school, and not having teachers and personnel who are trained to do that, and how we meet that.

My fear is that down the road, we will get to a point where people say I am not spending any money on this because nobody is doing anything with it. And I would like both of you to comment on the teacher training or somehow getting our personnel in school buildings up to speed so that they are integrating it into their curriculum and not just sending kids off to do a project in their free time.

Ms. MEANS. I share your concerns, Senator Murray, and nothing makes me feel more regret than walking into a school that has made a heavy investment in technology and walking past empty computer labs or going into classrooms with six unused computers in the back.

Not too many years ago I even walked into some of these schools, and these were in areas serving many low income students, and there would be plastic covers on the computer in the back to keep the dust off of it.

I think the key here is not to think of technology separately. Think of technology as part of whole school improvement. What is the tie to the mission of the school as a whole? We have a tendency to separate out programs and offer separate training. This is separate training on using the computer, separate from learning how to teach what you are supposed to teach.

The reason I think technology has caught on better at the elementary level is, in part, because those teachers feel a responsibility for multiple disciplines and can see a way in which technology supports some of the kinds of basic learning skills kids are getting at that age. At the high school level, teachers think more narrowly about their mission.

So I would like to see technology use combined with whole school improvement and, in fact, thinking about some support for professional development of principals in low income schools in particular because if the principal does not find a way to arrange the class schedule and the supportive time for teachers so that they can work on improving teaching and learning for their kids, both with and without technology, it will not happen.

Senator MURRAY. So include principal training as part of any teacher training program?

Ms. MEANS. I would love to have that happen and I think it is particularly a need in some of our large urban systems.

Mr. HYJEK. It is a particular need in some of our small rural systems, too.

I absolutely agree. In fact, we have had an administrative training program for I think 3 years now and it is growing into a second phase, where some of the alumni, if you will, from the first time around are coming back for a second training to upgrade some of their skills.

Typically we will run two- or three-day workshops in several parts of the State and a lot of what we are doing is working with administrators, first on some of their own technology skills, in some cases people who are not using technology, to give them some idea of what the power of this can be.

There is another agenda for us, which is also the analysis of data, which ties together with the school reform projects in Vermont. We are trying to get a lot more capacity at the principal level.

We are also trying to work with some superintendents. That is a little tougher one to sometimes work with, but we are getting there. So that is an important piece.

When we do planning before we get to the granting stage, a couple of things that we ask our schools to address is how they are going to provide on-going technical support. We had some experience a few years ago with a grant from Bell Atlantic where we tried to put together a project that Bell Atlantic put some substantial funds in, no training, and exactly what you said happened. All this hardware got put into schools, the connectivity was there and people said, "And what do we do with this?"

And Bell Atlantic, obviously as a corporate partner, was very disappointed, but we all were wrong because what we realized was the capacity was not there and it was almost the sense that the magic is going to happen if the hardware is there, and it did not. We learned a bad lesson.

Now fortunately, we did not lose Bell Atlantic as a corporate partner. They are still there working with us. We have IBM as a corporate partner. One of the things we have learned—in fact, we are doing a study right now that Bell Atlantic has funded which has to do with on-going technical support and for us, one of the difficulties with a small school, if you have a rural school of 150 kids, trying to find a technologist who can support that is hard. So we need to find ways to share people, so we are out there working with community colleges and training programs, doing some internships, and we are looking at trying to document how much support do you need, and that is an important piece.

We are asking school districts to talk about how are you going to have the on-going support? If the network goes down and teachers get frustrated, all that says is, "See, it is just another thing to get in the way of my teaching." And we do not want that to happen, obviously.

The other one is a plan for on-going financial support. I see TLCF funds as start-up funds, if you will. I do not think there is any intent that TLCF was ever supposed to provide all of the money for any school district. It is a way to get them going. It is a way to level the playing field, to address equity issues. But I think school districts need to look at how are they going to fund this in the future, how are they going to keep the computers upgraded or upgrade to newer hardware as the need arises?

And, of course, the professional development piece, which is important.

There is a broad continuum.

Senator MURRAY. And research, too, to show that all this is working.

Mr. HYJEK. Oh, absolutely. The research end, I think, really has to come much more, as you said, in the innovation side. The technology and literacy piece, our sense is really to fund the equity issues and the literacy part of that. We need to look to the research community to help us with that as a rationale, though, because obviously there are times when I have to go in front of a school board because a superintendent will call me up and say, "Can you come down and help me sell this plan? What does the research say?" So yes, we do need that.

But we need to have a continuum of professional development. If I have someone who is just starting, they may need some very basic skills in terms of using simple computer programs. We have other people who have been doing this for a long time and for us, in terms of moving toward standards-based instruction, we have two things happening at the same time.

We have an associates program in my organization where we take some of the most talented teachers in the State out of the classroom for a year, train them essentially as consultants, as mentors, and they go back into the classroom and they are modeling. We are finding that to be extremely effective. We want to expand that program because our sense is we cannot get inside the classroom.

So if you can come in and teach that lesson and use the technology and I can watch you do it, I can see that you can do it effectively, we can sit down, we can conference about that, you can mentor me and I am going to eventually be able to do it. And I am not doing it on my own. I have a critical friend to help me. We think that is how you get there. Again we are small.

Senator MURRAY. Which really actually goes to the second area, Mr. Chairman, if I can quickly ask about it, which is again, as I said, I am a big advocate of technology. I think there is a lot we need to do to keep it out there and show that it works, and I am confident if we do it right it will be great for kids.

But the other area is creating sort of an information underclass. That is the other challenge I think that could stop all of this in its tracks if we have a group that has and a group that has not.

And as we do our challenge grants and all these things, how do we make sure that those smaller rural districts who do not have a research grant person or may not have the community support behind it get the kind of support they need to get technology into their classrooms? It is as important, if not more important, in many of those communities.

Ms. MEANS. What I was suggesting is thinking about using the Federal level Technology Innovation Challenge Grants as a mechanism for developing and systematizing models, requiring solid research support for their effectiveness and understanding of the critical variables the make them effective. And then think of those as resources for local schools and districts under Technology Literacy Challenge funding, trying to use some of the research-demonstrated and validated models.

I think we can also think about using technology to help support both the implementation of these models, thinking about on-line networks of teachers actively communicating with each other about how to do this in classrooms, even though they are across the country from each other, and we can also think about putting, for example, evaluation resources in on-line databases. We are doing some of both of those things at SRI very effectively.

So if you have Federal funding for a model that has been research-validated and the Technology Innovation Challenge Grant has paid, for example, for the development of appropriate assessments for this particular model, appropriate survey instruments to test, all of that can be made available on the World Wide Web for use by local areas where they may not have the resources to develop those things or validate them on their own.

The CHAIRMAN. Senator DeWine.

Senator DEWINE. No questions. Thank you for your testimony.

The CHAIRMAN. Senator Bingaman.

[The prepared statement of Senator Bingaman follows:]

PREPARED STATEMENT OF SENATOR BINGAMAN

Just 5 years ago, Federal policy on education technology was still in its infancy. Lawmakers and educators were expressing interest in the area, and there were a few key studies and reports. Funding, however, for education technology programs was essentially limited to Star Schools and whatever surplus funds Title I and special education directors could spare. Few in Washington believed that my 1994 Technology for Education Act, the first major source of dedicated Federal funding for education technology, would ever attract much funding. But then the CD-ROM was relatively new and no one put E-mail and website addresses on their business cards either.

Those days are long gone. In FYI 1999, we've added a $425 million formula grant program dedicated to helping schools provide effective education technology instruction) over $100 million to help train teachers, and almost as much in a competitive grant program. There is a new $25 million research and evaluation program at the National Science Foundation, and after long delays, the first of over $1 billion in E-Rate telecommunications discounts are finally being released.

With this phenomenal growth has come criticism and attacks on Federal educational technology programs and their funding.

I believe that the main education technology challenge we now face is to rationalize the current set of Federal programs that have evolved since the 1994 enactment of my Technology for Education Act. Specifically, efforts at the Federal level should focus on just three main goals:

1.) Increasing access to technology for low-income students,

2.) Ensuring that classroom teachers have the preparation and training to use technology effectively, and

3.) Supporting research and evaluation of the impact of technology on student achievement.

Some of these objectives are outlined in my 1997 Technology for Teachers Act. All of these goals can be achieved through the reauthorization of the Elementary and Secondary Education Act.

In closing, I would like to thank Senators Jeffords, Kennedy, Murray, Harkin, and Cochran for their leadership in Federal educational technology programs. Today's hearing is the first step toward even more effective Federal support of education technology through the reauthorization of the Elementary and Secondary Education Act. Thank you.

Senator BINGAMAN. Let me just ask one question. We had a hearing in the Armed Services Committee yesterday on research and development activities that they are pursuing there. One of the areas they talked about was the work they are doing on what they call learner-centered instruction.

I asked them what they knew about that that we could use in our public schools and they said they were doing quite a bit of research on how to develop software which will adjust to the learning capability of each particular person who sits down to use a software program, and not just the speed with which you learn but the way in which you learn, as well.

I guess that sort of raises the larger question, are we doing any serious research on which of these technologies work, or is this just sort of whatever is produced in the marketplace, we just buy it and put it out there and see if anybody can get a benefit from it?

I have heard the criticism made that in education we spend less on research in education than they spend on research in virtually any other activity, human activity, and I just am concerned about that. I wondered if you think we are doing what we should be doing in research or what should we be doing?

Ms. MEANS. I think that if you look across Federal agencies, that in addition to the Department of Defense investments that you referred to, there has also been a significant investment on the part of the National Science Foundation, looking at the use, for example, of visualization and simulations in teaching physics concepts, in teaching calculus concepts to urban middle school students.

Outside the National Science Foundation, there is very little investment in looking at what kinds of technology works best for teaching other areas—for example, historical analysis, social studies areas, writing areas. We see very little Federal investment there and——

Senator BINGAMAN. Maybe you could pull that microphone up a little bit. I can barely hear you.

Ms. MEANS. Oh, I am sorry.

We see very little investment in this kind of research outside the National Science Foundation, so it means that, in fact, the body of research is lopsided, with much more known in the area of mathematics and science than in other subject areas that are also important, and I think that has been a neglected area.

Senator BINGAMAN. Is there any mechanism for people in the education field learning what the National Science Foundation is finding out or what the Department of Defense is finding out, other than coming to these hearings?

Ms. MEANS. Certainly there are individual reports available. There are many, many web sites one can go to. But we have not had, I would say, a kind of omnibus trusted resource reviewing research across agencies and across subject areas and providing that information to the general public. I think it is an area where a lot more could be done by the Department of Education.

But I do want to caution against what I have sometimes heard, maybe more 5 years ago than today, but there was the notion that we know everything about how to educate our students and that we just have to tell people better, and I do not think we are at that stage yet.

Mr. HYJEK. I am a little at a loss as far as making a comment. I am not a researcher, so I do not want to get outside of my field, but I did want to comment on the NSF piece.

In Vermont we are fortunate enough to have an NSF-funded State-wide systemic initiative working in math, science and technology, so we do have a mechanism to get that kind of information to our teachers through a number of training programs that we do. We are using on-line resources, the World Wide Web more and more to deliver those kinds of things.

And certainly one of the things that I hear from school people who have Technology Literacy Challenge Fund grants is a real need for more research. They are, in fact, asking for it. There is real concern out there about accountability and they are interested.

So I think that the need is there. We do not have as much information yet coming out of the research community. I think we can put it to good use when we do have it, but I have not seen an awful lot. Anything that comes out gets gobbled up and discussed and worked on quite a bit.

Senator BINGAMAN. Thank you very much.

The CHAIRMAN. One last question. There are three areas that right now we need real help. First of all is the social promotion problem, holding kids back to get them to read. We have, at least in many areas, massive problems in this regard. What role can technology take to try to bring kids up to speed on reading and math?

The second one is the gifted and talented, which we do not really, at least most schools that I know of do not really have any good programs for them. They are frustrated. Is there any real look at these?

And then related to that is professional development for teachers. We have now millions of teachers out there that really have not had the experience with technology and how to utilize it. Can technology be used to help those people get to a position to be able to have the advantages of technology?

Ms. MEANS. I think I will start with the last issue. One of the things we have been interested in looking at at SRI is the use of technology to support teacher professional development. If you will recall my comment, it is important to have on-going development—do not think of this as a one-afternoon activity—and also to combine it with the subject matter. That might give you some clues to the kind of thing that we are doing.

We have a virtual teacher network called Tapped In. You can see it at www.tappedin.org. Here what we have done is partner with organizations that are concerned with improving teacher quality in areas such as mathematics, science, and they, in fact, have their teachers come to this virtual place, interact with each other, interact with researchers and experts in their content area over a virtual network.

Many of the teachers do it at home in the morning in their jammies—that is what they like to say. It creates extra opportunities for them to get professional development without having to leave the place where they are and without having to leave their time in the classroom.

So I think opportunities such as this—we now have 3,200 educators involved in this—have a lot of promise for the future. That addresses one of your points.

Mr. HYJEK. I will start on the other side. Obviously I think there are applications for all of those points that you raise, Senator. We have several projects in Vermont right now where we have schools that are very concerned about students who are in need of remedial help, and they have begun using technology. And again some of this is commercially produced software, but things that are quite effective, that allow students to work somewhat at their own pace but work against a standard, whether it is learning multiplication facts or whether it is developing phonetic or phonemic awareness or learning about the structure of language, or even just reading skills, as they read through text and develop comprehension skills by then answering questions.

We are finding those things are very effective, especially in the earlier grades. And I think the research would show that if we can remediate early, then we can get kids caught up and we have a chance of keeping them successful throughout their career.

On the other side, as far as gifted and talented, I think that just the use of information technology in a very broad spectrum, being able to use the World Wide Web, and in a standards-based environment, if I have a student who is extremely interested in some aspect of biology or astronomy or whatever, I can create a unit as a teacher and send that student out with some direction, maybe with the help of a library media person to do research, both in print, also on the Internet, look at the viability of resources, put that together in a paper or by using a spreadsheet and graphing, building a database, putting that into a Power Point presentation and maybe making a presentation to the class or to other classes.

So I think there are ways for us to use the technology that are almost limitless. Having connections with students in other schools or taking part in a class, possibly already at a university.

The professional development piece again I spoke of before and I think a couple of things. For us in Vermont, the regional approach seems to be important. We have some problems with geography, especially in the winter, getting people to go to colleges. But also we found that if we can deliver real-time, as-needed professional development to the school, to the desktop, by using the Internet or by using a dedicated real-time video network, we can get people a lot more interested in professional development.

We can also use that network for students to be able to participate in classes. As you know, Senator, we have a lot of small rural high schools that really cannot offer comprehensive programs simply because they are not big enough. And often students do not have opportunities to take part in advanced placement courses that they might if they were in—I was going to say urban but I think in Vermont we do not have any urban centers, but in larger areas, in larger schools.

And this is something we are very seriously exploring right now with partners. We are working with Bell Atlantic, we are working with Cabletron, we are working with IBM in hopes that over the next few years, we can have that kind of system in place that will serve both students and teachers, to extend opportunities for kids, especially in the gifted and talented area, the advanced placement area, but also in teacher professional development.

The CHAIRMAN. Well, I would like to keep you all day. I just may not have enough knowledge, but I get frustrated at trying to think how we can better use all this massive information that is out there, with regard to technology, and other programs. And, how if I were a teacher, I would know what to use or what to do or what works or what does not work. I would feel very frustrated. And I see heads both nodding yes.

We will take a five-minute break now because the next one is an interesting demonstration of how some things work. So we will take a five-minute break.

[Recess.]

The CHAIRMAN. Well, I believe we are in store for some interesting and exciting demonstrations here. Let me introduce the first two panelists and then we will have the demonstration.

I want to welcome PBS president and chief executive officer Mr. Ervin Duggan to the committee. During the last 5 years Mr. Duggan has taken PBS to a new level of excellence in programming by bringing innovation to its efforts in education and technology. PBS Mathline is one such initiative that uses a blend of technologies to help teachers across the country assist students in reaching the national goals of mathematics and education achievement.

He is joined by Mr. Daniel Hogan, a former math teacher and now district technology coordinator who knows first-hand how effective PBS Mathline can be. We look forward to both of your testimonies.

I would like to ask now for Senator DeWine to enlighten us.

Senator DEWINE. Thank you, Mr. Chairman. I apologize for coming back and forth. We have a mark-up going on in the Judiciary Committee and they keep needing a quorum and getting me down there.

It is my pleasure today to introduce two witnesses from my home State of Ohio. Over the past 4 years, Ohio has made a serious investment in the creation of a State-wide integrated education technology network known as SchoolNet. The State has provided over $300 million to wire every school for voice, video and data transmission and is currently in the process of creating one computer work station for every five children in grades K through 4.

With such a serious investment in technology, Ohio has been wise in its attention to the need for quality professional development that occurs in step with the introduction of computers in classrooms.

We have with us today, as you have indicated, two Ohio educators that are excellent examples of Ohio's success in this coordination. Daniel Hogan is the district technology coordinator for Ross Schools and is here to talk about one of the ways technology can improve teacher training.

Under Ohio's SchoolNet program, coordinators such as Mr. Hogan are responsible for assembling and overseeing a district's technology program. Mr. Hogan is recognized as one of the most effective coordinators in the Nation.

Georgene Lytle is also with us today from Wooster City Schools in Wooster, OH. Ms. Lytle will be leading us in an on-line science demonstration of how technology, such as the popular JASON Project, can capture our children's attention and improve their learning opportunities. We welcome both of them and all of our witnesses and I appreciate the opportunity to introduce them, Mr. Chairman.

The CHAIRMAN. Thank you. I think Senator Bingaman has Dr. Gonzales.

Senator BINGAMAN. Yes, let me also introduce one of our witnesses, Mr. Chairman, Dr. Carmen Gonzales, who is from New Mexico, Santa Fe originally, now New Mexico State University, a faculty member there with the Department of Curriculum and Instruction in the Learning Technologies Program at New Mexico State. So she is currently the project director for the Department of Education Technology Innovation Challenge Grant called Regional Educational Technology Assistance, and I think that is a subject of her testimony today and we are very proud to have her here and the work she does.

Thank you for having the hearing, Mr. Chairman.

The CHAIRMAN. Well, thank you, and I will introduce the balance of the panel now.

Dr. Michael Pitroff is project director of the Baltimore Learning Community, an education technology initiative helping to bridge the gap between classroom learning and workplace preparation. We look forward to hearing from you later and learning more about how the Baltimore Public Schools have helped put school to work. I visited there, I guess, Marion Pines, probably 20 years ago, so I guess you are still at it.

Mr. PITROFF. Yes, we are.

The CHAIRMAN. And Dr. Inabeth Miller is president of the JASON Foundation for Education. The JASON Project is an innovative science initiative that brings the excitement of scientific expedition and discovery to students through a combination of technologies. Accompanying Dr. Miller is Georgene Lytle, a third grade teacher and primary interactive network site coordinator from Ohio.

So I thank you very much and please proceed, Doctor.

STATEMENT OF ERVIN DUGGAN, PRESIDENT, PUBLIC BROADCASTING SERVICE, ALEXANDRIA, VA; DANIEL HOGAN, PARTICIPANT, PBS MATHLINE PROGRAM, CINCINNATI, OH; INABETH MILLER, PRESIDENT, THE JASON FOUNDATION FOR EDUCATION, WALTHAM, MA, ACCOMPANIED BY GEORGENE LYTLE, THIRD GRADE TEACHER, WOOSTER, OH; MICHAEL PITROFF, PROJECT DIRECTOR, BALTIMORE LEARNING COMMUNITY, BALTIMORE, MD; AND CARMEN GONZALES, DIRECTOR, REGIONAL EDUCATIONAL TECHNOLOGY ASSISTANCE PROJECT, NEW MEXICO STATE UNIVERSITY, LAS CRUCES, NM

Mr. DUGGAN. Thank you, Chairman Jeffords, members of the committee. I am Ervin Duggan of PBS and we are tremendously grateful for this opportunity to talk about one effective use of technology in teacher training.

I want to begin, however, with a very important and very basic point. All of these marvelous new digital technologies that are coming on stream—HDTV, multicasting, broadband—all of these things are going to be terrific for games, they are going to be wonderful for entertainment, they are going to be broadly applied in commercial uses. The only hope, the only chance for using these wonderful technologies for education, for culture and citizenship is for leaders like you and members of this committee and the Congress to encourage nonprofit educational institutions like those represented here, including public broadcasting, to experiment with these technologies, to penetrate them into schools and to create content. The most important thing is content. Wires and waves are worth nothing without good educational content for teachers and students.

So your leadership is very important, Senator, in ensuring that these technologies will be used for more than commercial and pleasurable entertainment uses.

In 1994 this committee and the Congress created two Title III programs under ESEA that I want to mention today and thank you for. The first was called Ready to Learn Television for young children, the second, the Telecommunications Demonstration Project for Math. That led to PBS Mathline, which we will be talking about today.

We are tremendously grateful to you, to members of this committee for your interest, to the staff, who have come over to PBS and have been pioneers in taking tremendous interest in these programs. They would not exist without the interest and leadership that you have shown.

Today specifically I want to talk about Mathline, which is up and running and we believe has tremendous potential to accomplish the things that the first two witnesses were talking about today.

PBS Mathline is a telecommunications training project for teachers. Its purpose at its inception was to spread the new voluntary national math standards widely and quickly to teachers and schools across the Nation using the phenomenal efficiency of the public television system.

The way that it operates is very simple. It is so simple that the simplicity of it belies the revolutionary nature of it.

First, we use videos, a very familiar technology, videos that teachers can pop right into the VCR at home or at school at any time without going to a campus. They can watch master teachers at work using the new math standards at various grade levels, the grade level appropriate to that teacher.

We then assemble those teachers into what we call on-line learning communities using on-line technology so that the teachers can communicate with one another about what they are learning, so that they can ask questions and solve problems together. Teachers watch the videos, they absorb the skills, they see the new standards at work, they see innovative teaching methods at work, and then they talk to each other about what they are learning. It is very simple but it is very revolutionary.

Think of one revolution. We break teachers out of the professional isolation. The bright fifth grade math teacher may not have a colleague or many colleagues to whom he or she can talk and solve problems. The on-line community enables that teacher to communicate with other math teachers all across the country and to break out of the professional isolation that has been one of the difficulties and handicaps that teachers operate under.

We know, after a few years of operation with PBS Mathline, that teachers love this service. They love the way it works. It spreads the standards quickly. It improves skills, both among teachers and students, because they are getting those innovative teaching methods into the classroom quickly, and it enables them to create communities that talk together and solve problems.

The challenge now, Senator, is to scale this program up from a small demonstration project to one that will reach literally hundreds of thousands of math teachers across the country with this new technology, which is easy to use and tremendously effective.

We also hope to spread it across the curriculum. Think of PBS Scienceline, for example, PBS Heritage for history teachers or PBS Expressions for teachers of language arts, to improve the skills of teachers using simple but highly effective technology.

As we look to the possibility of expanding this project, we at PBS are already setting about to do four things. First, we are going to migrate Mathline to the World Wide Web. We now have sophisticated technologies like videostreaming that will enable us to put the video training on the World Wide Web so that teachers can access it even more conveniently.

Second, using current funds, we plan to create 10,000 scholarships to break the cost barriers to Mathline so that thousands and thousands of teachers can use this service for free.

Third, with new funds that we hope to get with your leadership, we want to train not only teachers who are already operating in the classroom but future teachers who are being educated to teach in the future, to give them the advantage of services like PBS Mathline.

Fourth and finally, we hope to expand the training of teachers and technology across the board, both the use of technology to improve their own skills and the use of technology in the classroom to help improve their student skills.

We are mindful, as we look toward all this, of a tremendous challenge—the need to convert the entire public broadcasting and educational broadcasting system to digital technology, and as we go forward we will need your help, the help of other committees and other Members of Congress in that.

Today we want to give you an exciting demonstration of one way that digital technology can be used almost magically to create new educational components that can be packaged along with a television program and sent to homes and schools across the country. It is an interactive component of Ken Burns' Frank Lloyd Wright documentary and we hope you will have a chance to see that today.

Now, Mr. Chairman, because the testimony of an actual classroom teacher is the best advertisement of all for the success of any experiment like this, I am happy to introduce the district technology coordinator for the Ross local schools in Ohio. He is also the local Mathline facilitator, working with local PBS station WCET Cincinnati. He is Daniel Hogan and we are delighted to have him here today. Dan?

[The prepared statement of Mr. Duggan follows:]

PREPARED STATEMENT OF ERVIN S. DUGGAN

Mr. Chairman, Senator Kennedy, members of the Committee: I appreciate this opportunity to appear before you—to outline our views on educational technology and teacher professional development.

The center of my brief testimony is this single, simple point: As digital technology reshapes the media landscape, it will be used mostly for entertainment and for commercial purposes. The only chance—the only hope—of using this marvelous technology to advance education, to enrich our culture and to enhance citizenship will come from public television.

Taken together, PBS and its member stations constitute the nation's single largest nonprofit educational and cultural institution. We reach every home in the nation—and virtually every school. Seventy percent of teachers report that they use our materials in the classroom; and eight out of 10 teachers who use video in the classroom say that PBS is their first choice. So it is only natural that we should use our infrastructure, our technology and our content to help teachers learn and grow and develop as professionals.

As part of the reauthorization of the Elementary and Secondary Education Act in 1994, this Committee and Congress created the Ready To Learn Television Program, of which we are tremendously proud. You also created the Telecommunications Demonstration Project for Mathematics. This project funded PBS MATHLINE, through which PBS has pioneered and refined a new model of teacher professional development. MATHLINE is the subject of our testimony today, but let me express our deep gratitude to you for your leadership in creating both of these programs.

MATHLINE was created specifically to educate teachers about the new national voluntary standards for teaching and learning, developed by the National Council of Teachers of Mathematics (NCTM). MATHINE uses videos of master teachers at work. It then assembles math teachers in on-line learning communities, led by trained facilitators, using the technology of the Internet. This dual approach allows teachers to learn the new standards by watching—and then to converse on-line with peers and master teachers to reinforce what they learn. MATHLINE breaks through the professional isolation of teachers. It helps good teachers become better teachers. It's a simple, but revolutionary, way to encourage higher achievement in mathematics in K-12 classrooms nationwide.

Our research into the effectiveness of MATHLINE suggests that teachers highly value MATHLINE as a tool for improving their skills. So that you can see the enthusiasm they express, I've submitted, as an attachment to my written testimony, comments from teachers around the country about MATHLINE.

Mr. Chairman, we are strongly convinced that it's now time to scale MATHLINE up—from a demonstration project that has reached 5,800 teachers to a full-fledged program that can reach tens of thousands, even hundreds of thousands, of teachers. Let me describe to you the steps we are prepared to take in this effort:

First, we are migrating MATHLINE to the World Wide Web. The latest Dun & Bradstreet figures from 1998 reveal that 85 percent of the nation's schools are wired to the Internet, and that thousands of teachers use the Web daily. We have launched a major site devoted to MATHLINE on our award-winning Internet site, PBS ONLINE. Later this year, we will begin streaming our MATHLINE video teaching demonstrations, on demand, to teachers—and we will supplement the site with additional teaching models and lesson plans.

Second, we plan to expand the reach of MATHLINE far beyond its current level. Using current funds from the program, PBS will create 10,000 MATHLINE scholarships for K-12 teachers throughout the country in the 1999-2000 school year. These scholarships will nearly double the number of teachers reached by MATHLINE. This will put the program within the reach of many schools whose professional development budgets have been too tight, or have been committed elsewhere.

Third, using an increased appropriation from Congress for fiscal 1999, MATHLINE will provide pre-service training for future teachers as well as in-service professional development for teachers. We will start this, as well, in the 2000-2001 school year. One of PBS's best-kept secrets is our PBS Adult Learning Service, which beams a vast array of distance learning telecourses to two-thirds of the nation's colleges and universities by satellite and over the Internet. This is an existing delivery system which can help schools and colleges of education now to prepare teachers for the 21st Century.

Fourth and finally, we will expand our efforts to train teachers to use technology skillfully in the classroom. Our technology-training initiative for math teachers will be keyed to the newly updated mathematics standards now under development by the National Council of Teachers of Mathematics.

As we contemplate our expansion of these educational technology programs, we are mindful of an enormous opportunity that is also an enormous challenge: the transition of PBS and its member stations to digital broadcasting. Digital television has the potential to expand dramatically the educational services that PBS and local stations can offer. State and federal programs, including the "E-rate," are helping to build digital networks for schools across the nation. These new networks will be irrelevant, however, without the educational content they need. We can supply that content. We need your support for continued funding, however, to meet this demand.

We therefore respectfully ask the Committee to work with us to expand the MATHLINE model for the digital age. Along with my written testimony, I have submitted a proposal that outlines how this model can be spread across the curriculum; how it can improve teaching in science and social studies, as we expand the creative use of media technology in the classroom.

We also have available today an exciting demonstration of how digital technology can create a wholly new kind of teaching resource. It is an interactive component of Ken Burn's documentary on Frank Lloyd Wright. We would be glad to show you this brief demonstration during the question and answer period or after this hearing.

And now, Mr. Chairman—because the best endorsement of MATHLINE is the testimony of a teacher I am happy to introduce Daniel Hogan, a highly experienced classroom teacher. Mr. Hogan last year became the district technology coordinator for the Ross Local Schools in Ohio. He also is the local facilitator for PBS MATHLINE, working through public station WCET in Cincinnati. With your permission, he can describe firsthand how MATHLINE works in his district. Dan?

PBS MATHILINE

Telecommunications Demonstration Project for Mathematics

FY 2000 and ESEA Reauthorization Proposals

success to date

During the past four years, the Telecommunications Demonstration Project for Mathematics, authorized in the ESEA amendments of 1994, has allowed the Public Broadcasting Service to pioneer and refine a new model of teacher professional development for teachers K–12. PBS MATHLINE uses video modeling of standards-based lessons, combined with on-line learning communities of teachers led by trained facilitators, to help mathematics teachers from elementary through high school adopt and implement standards-based practices in their classrooms. This approach allows teachers to update their skills on their own schedules through video, while providing on-line interaction with peers and master teachers to reinforce that learning. This integrated, self-paced approach breaks down the isolation of classroom teaching while making standards-based "best practices" available to all participants.

MATHLINE was developed specifically to disseminate the first national voluntary standards for teaching and learning as developed by the National Council of Teachers of Mathematics (NCTM). MATHLINE began as the "Middle School Math Project," expanded in Year 2 to the "Elementary School Math Project," and in Year 3 to the "High School Math Project." During three years of actual deployment, more than 5,800 teachers have participated for a least a full year in the demonstration. These teachers, in turn, have taught more than 1.5 million students, cumulatively.

In the first three years of the MATHLINE project, PBS used the largest portion of the ESEA funds to produce video-based models of classroom teaching; to produce and disseminate extensive accompanying print materials; to organize and host professionally moderated, year-long, on-line learning communities; and to train PBS stations to deploy MATHLINE in their local communities. In FY 1998, PBS added an extensive Internet-based set of learning tools for teachers' use with the video modules and printed materials, and it expanded the online resources available to teachers through Internet-based discussion groups and a national listserve. To extend federal funds, PBS has experimented with various fee models for teacher participation, with varying results. Using both FY 98 federal funds and private money, PBS will dramatically expand participation in MATHLINE by making approximately 10,000 MATHLINE "scholarships" available to pre-service and in-service teachers without charge. PBS and its participating member stations will distribute scholarships to each state and US territory. Teachers serving disadvantaged populations will be given priority in the selection of scholarship recipients.

For FY 99, Congress increased funding for the Telecommunications Demonstration Project for Mathematics from $2 million to $5 million. Funds were appropriated to continue MATHLINE and expand its reach, plus extend the successful MATHLINE model to provide in-service and pre-service training to teachers in the use of technology in the classroom. These expanded activities, including a greater number of scholarships, will begin with the 1999-2000 school year.

evaluations

Independent evaluations indicate that teaching improves and students benefit as a result of the program. Annual evaluations, which have been provided to the Department of Education each year, have demonstrated that teachers participating in MATHLINE have found the program to be highly useful in expanding teachers' knowledge and use of new math standards and in "networking" teachers electronically to share classroom experiences and techniques. The studies have also shown that many MATHLINE participants are changing the way they teach in the classroom after participating in the program-a key indicator that teachers are internalizing the training and using it in their professional lives. Details of these studies are available from PBS.

FY 2000 Appropriation Request

PBS believes that the "demonstration" nature of MATHLINE has proven the durability and effectiveness of the teaching model, and that the "scholarship" model for disseminating MATHLINE is the most effective in spreading the program to the greatest number of math teachers in the United States. Accordingly, PBS is requesting $8.5 million, an increase from $5 million, to transition PBS MATHLINE from a demonstration to a distributed teacher professional development program with true national reach and expanded subject areas. Funds are needed for the following purposes:

1) **Upgrading training resources for new mathematics teaching standards, TIMSS, and NAEP.** The National Council of Teachers of Mathematics (NCTM), MATHLINE's original partner, is updating its landmark voluntary standards. "NCTM Standards 2000" will include, among other changes, a strong technology component that was not present in the original standards. MATHLINE will update and create video and other resources to reflect the best practices for incorporating the new standards in the classroom. MATHLINE content will also more directly address the findings of the Third International Mathematics and Science Survey (TIMSS) and the National Assessment of Education Progress (NAEP). The professional moderators of the on-line learning communities will receive retraining to reflect Standards 2000, TIMSS, and NAEP as well. Also, for the first time, MATHLINE will create resources that can be used directly by teachers as learning resources for students.

2) **Developing a national certificate program in the use of technology in the mathematics classroom.** Based on its work in technology training made possible with FY 99 appropriations, PBS will use its vast distance-learning capabilities in broadcasting, satellite distribution and World Wide Web site to design and deploy a voluntary national certificate program in educational technology. Using these telecommunications platforms and its alliances with hundreds of colleges and universities across the country, PBS will create video-, print- and Web-based training resources and certificate programs for both in-service and pre-service teachers. Certificates will be awarded to teachers, and teaching students, who have successfully completed approved courses in the integration of technology in the classroom. PBS will work with institutions of higher education, teacher professional organizations, the International Society for Technology in Education (ISTE) and other organizations to create this certificate program. The professional development curriculum resources for the certificate program will draw largely from the Standards 2000 resources for math teachers, but will include modules for the use of technology in all subjects.

3) **Further expanding the reach of MATHLINE.** PBS will continue its dramatic expansion of the reach of MATHLINE. With currently appropriated funds, 10,000 scholarships will be awarded to teachers for the 1999–2000 school year. With the requested increase in federal funding to $8.5 million, PBS will expand the scholarship program to 30,000 in-service and pre-service teachers by the 2001–2002 school year. This five-fold expansion of MATHLINE's current reach will bring the benefits of professional development in mathematics and technology-based instruction to a much wider range of in-service and pre-service teachers.

ESEA Reauthorization Request: "New Century Program for Distributed Teacher Professional Development"

This proposal would amend or replace Title III, Part D of the ESEA, the "Telecommunications Demonstration Project for Mathematics." Based on its five years of experience in technology-based teacher professional development, its historic educational mission, and its imminent deployment of digital broadcasting technology through its 350 member stations, PBS proposes to launch a dramatically scaled-up version of teacher professional development in all major curriculum areas through **"The New Century Program for Distributed Teacher Professional Development."** We propose that the ESEA be amended to authorize funding that could make this program possible.

The New Century Program will link the digitized public broadcasting infrastructure with the emerging education networks being built by state and federal grant programs and with the "E-rate" program for school technology. Working with its "digital membership" and state and federal agencies, PBS will expand upon the successful MATHLINE model to reach tens of thousands of teachers to advance their teaching skills and their ability to integrate technology into teaching and learning. The New Century Program also will leverage PBS's historic relationships with higher education to improve pre-service teacher training.

The New Century Program will include the following elements:

1) **Expanded teacher professional development content in core curriculum areas. PBS will update and expand professional development offerings to teachers to include new mathematics, science and social studies (focusing on American history and culture). Specifically:**

- **Mathematics.** PBS will expand its base of MATHLINE content and link it to state standards and state assessments. The links will be created through specially authored MATHLINE content modules that are linked to a database of state mathematics standards. This will permit relatively simple customization of PBS resources for maximum effectiveness at the state level. PBS will also continue to develop content that addresses the recommendations of the Third International Mathematics and Science Survey (TIMSS) and other assessment tools.

Science. To develop a science program along the lines of MATHLINE, PBS has invested more than $1 million in non-federal funds in FY 98 to create PBS SCIENCELINE. The first phase of SCIENCELINE is designed for the K-5 teaching profession. It consists of 12 video modules, 20–30 minutes each, that model inquiry-based teaching to create engaging, relevant learning experiences for their students. SCIENCELINE teachers also are enrolled in facilitated online learning communities that provide a place where they can ask questions, discuss concepts addressed in the videos and share experiences with colleagues. These online learning communities use Web-based forum software that is accessible through any Web browser. In other words, teachers with Web access do not need any special software in order to participate. SCIENCELINE will be expanded to the middle and high school levels in the next phase of this New Century Program.

- **Social studies (focusing on American history).** In FY 98, PBS introduced a comprehensive PBS Database of American History and Culture. The database contains more than 270 broadcast-quality video volumes covering the entire history of America—from Native-American cultures through the Colonial, Revolutionary and early National periods, the industrial revolution, World War I, the Great Depression and World War II, the Civil Rights Movement, the space race and the Cold War, and the technology revolution of the late 20th Century. The database also includes two sets of printed curricula and a comprehensive Web-based search engine that provides pinpoint access to video segments anywhere in the database in just seconds. PBS will use this database as a platform from which to develop professional development courseware in social studies along the lines of MATHLINE and SCIENCELINE for elementary, middle and high school.
- Technology training. Using the resources of its distance-learning division, PBS will develop a new, ongoing professional development program to help teachers learn how to use technology in the classroom. Technologies included in the training modules will include computers, the Internet and digital video in all of its forms—videostreaming, digital satellite delivery and digital terrestrial broadcasting. PBS will work with its network of more than 1,000 colleges and universities to create a pre-service program as well as in-service programs for teachers in all disciplines.

2) **Create an Educational Technology Certificate Program.** The elements of this New Century Program described above are voluntary skill-building activities for teachers. PBS will take technology-based professional development even further under the New Century Program by creating a formal Certificate Program in Educational Technology for teachers seeking a professional credential in technology training. PBS will work with institutions of higher education, teacher professional associations, the International Society for Technology in Education ([STE), and other organizations to create this credential for teachers who successfully complete PBSs professional development courses, such as MATHLINE or TECHLINE. This certificate program will be part of a family of comprehensive lifelong learning certificate programs that PBS is creating for teaching and other professions. Certification will be developed and awarded with selected partner colleges and universities in consultation with state education agencies.

3) **Expand reach through free or low-cost dissemination.** Fee-based models attempted during the Telecommunications Demonstration Project for Mathematics met with mixed results. PBS is proposing funding at levels to make the New Century Program available to tens of thousands of in-service and pre-service teachers. PBS will particularly target school districts in disadvantaged and rural areas and will work with its vast community of member stations to ensure a close, local working relationship with school districts and teachers who participate.

4) **Provide for distribution across "low-tech" and "high-tech" platforms.** PBS is uniquely suited to distribute the elements of the New Century Program in every means that teachers might find convenient. These include:

- Print distribution of guides, curriculum materials and other supporting material, particularly through PBSs 350 member stations;
- Video cassette distribution of video modules;
- Web-based video streaming of video modules through PBS TeacherSource, the Internet-based "neighborhood" for teachers on PBS ONLINE, named in 1997 and 1998 in Market Data Retrieval studies by teachers as one of the three top Web sites for classroom use;
- Digital video broadcasting through digital multicast channels on local public television stations, which will begin in 2000 to approximately 35 percent of the United States and expand rapidly from there;
- Data-enhanced digital broadcasting, which can deliver not only the video courseware but also simultaneously deliver all of the data elements, including com-

plete web sites, to DTV-equipped set-top receivers or personal computers through technology already developed and deployed by PBS and the Intel Corporation;

- Teacher-to-teacher video conferencing through PBS distance-learning satellite network and through PBS ONLINE on the Internet;
- And on CDROM and DVD ROM through the publishing units of PBS Interactive and local station publishing efforts such as WGBH Interactive, Iowa Public Television, KUED Salt Lake City and other initiatives.

To fund content development and distribution of the New Century Program on a national scale, PBS requests that appropriations be authorized at $20 million for FY 2000 and such sums as may be necessary for each succeeding year.

Comments by Teachers about PBS MATHLINE

"MATHLINE is the most unique and valuable tool for teachers to come along!"

LINDA BULLARD
Gurdon, Arkansas

"I have been teaching 15 years, and have never had a year as exciting as this one, The combination of the technology movement into public education and the PBS MATHLINE program have given my teaching a shot in the arm . . . MATHLINE has helped me to understand what math education needs to be to meet the demands of the 21st century.

MARJORIE STREET
Cantonmnet, Florida

"I have been amazed that the videotapes have been only the starting point. The interactions—sharing, questioning, debating—have been the highlight of the program, Being able to bridge the distances and isolation, while sharing successes and concerns with other educators has been a most rewarding (and unexpected) aspect of my MATHLINE year."

BETH SKIPPER
Hammond, Louisiana

"MATHLINE has been a lifeline. The on-line information together with the videos are a great, effective, energizing, non-threatening way to stimulate change in the classroom and to begin to implement the National Council of Teachers of Mathematics (NCTM) Standards."

MARY MACNEIL
Maiden, Massachusetts

"Working with MATHLINE has been a very exciting experience for me. Knowing that in some way I have helped to improve mathematics education in Mississippi is very gratifying, Thank you for providing this wonderful tool to help teachers learn and in turn, help their students learn."

CONNIE MURPHREE
Tunica, Mississippi

"The variety of lessons and topics cover a wide spectrum of the NCTM Standards, but the best part is the opportunity to discuss, from a professional standpoint, what is happening in each lesson, ideas for extending the lesson, educating parents about the need for reform, and a multitude of other issues. Each evening, I have a professional development experience on-line!"

LINDA GOJACK
Lyndhurst, Ohio

"I was really excited when I first heard about MATHLINE . . . the perfect use for video and computers-to provide instruction to everyone. Not everyone can go to the conferences, not every school has staff development activities for the staff and this program provides it all for everyone. What a great network of instruction, example, discussion and support."

DEBRA KERR
Tyrone, Pennsylvania

"MATHLINE has proven to (be) the professional resource I found lacking in my career."

SUE MORENCY
Menomonee Falls, Wisconsin

These comments are from the Algebraic Thinking Math Project Pilot Program completed in March:

"The video enables me to be more confident in my presentation of the lesson to my own class."

"The video was especially helpful in preparing the lesson . . . it made the whole activity make sense."

"The students and I had a lot of fun completing this activity, They truly enjoyed the challenge. I am always amazed at how well they can solve problems presented in this type of format,"

Why the participants enjoyed being online

"It has been wonderful communicating with fellow educators from all over the country. I have enjoyed meeting them and finding that we all have similar problems, etc. I have also enjoyed going through this project with teachers from other levels and seeing their successes and difficulties."

"I really enjoy hearing what others have to say about what does or does not work, and it is very convenient being online and connecting while there!"

"I think the online conference environment is fantastic! We have an opportunity to discuss pedagogy with teachers of various levels from all over North America. That is awesome! As a MATHLINE facilitator for two years I think the use of online communication is a great avenue through which we can exchange ideas."

"It is great and a way to get resources and information that meets the need of busy teachers and time limitations, It certainly beats taking time off from school, travelling and expense reports!"

"The online dialogue makes teaching a lot less isolated. I like hearing all the ideas—trials, tribulations, and triumphs—from across the country."

"I got many good ideas from other teachers. We can benefit a lot from hearing others' experiences and then taking that knowledge and adapting it to our own situations."

Changes in approach to moth teaching

"I have renewed my efforts to find more problems involved in finding patterns and generalizing them. I was encouraged to see group work such an integral part."

"I was encouraged to challenge my young students with a concept that I had viewed as pretty difficult!"

"This was the first time I have used a hands-on approach to teaching patterning. I enjoy using manipulatives, it was great for me to use an exciting approach to patterning."

"Using a spreadsheet was not something I have attempted in the classroom, but seeing how it was done in the samples encouraged me to do so."

From an article in the National Council of Supervisors of Mathematics Journal of Mathematics Education Leadership, titled "Mathline for Pre-Service Teachers!"

Pre-Service student participants

"Excellent! (Mathline) promotes in depth discussions which lead to new innovative ideas."

"Mathline was an excellent way for us to see both the teacher and the student perspective. This allowed us to be taught and to see how these types of activities went in the classroom. It allowed us to see the positive and negative aspects."

"As a student, I learned from the lessons, then watched someone else teaching and learning, so I could see them from a new perspective."

"I really enjoyed this class! Actually seeing teachers teach was good for me. . . . Responding to the activities helped me. I have never had this type of thing before. I felt that the material and assignments were useful,"

"(Mathline) was the most valuable math class I have taken here. The other classes give me a chance to learn the material I need to learn, In Mathline I learn how to implement the material, I learned how to lesson plan. . . . (viewing the lesson) allowed me to evaluate the lesson and decide what I would include in my lesson. Being online also gave me an idea of how I can go about finding help."

"Good course! The best I have taken here. It has taught me how to implement what I have learned in other classes into lesson plans."

"The (Mathline) videos show the process that the teacher goes through to develop the lesson. We see how to take a lesson off a page and put it into action. I enjoyed the chance to network with an in-service teacher. Our class was an excellent way to discuss the videos."

"This course is totally awesome. It gives us a chance to discuss the teaching going on that we see in the videos. We have an open format and can discuss exactly what we think, This has been the best class that allows us to learn how to teach. Other classes seem to teach us how lessons are done and not HOW to teach it."

The article was written by Dr. Cynthia L. Ramey, Central Missouri State University, Warrensburg, MO (660) 543-4386, ramey@cmsul.cmsu.edu

Mr. HOGAN. I would like to thank the chairman and the members of the committee for giving me this opportunity to be here today.

Again a little background. I was a math teacher in a high school for 28 years before last year, taking over a new position in the district called district technology coordinator, and maybe when we come back for the question and answer part, I want to address maybe the need in that area, also.

But over the past 4 years, through generous public and private funding, PBS has been able to build the PBS Mathline's innovative approach to improving K through 12 math education in the United States. As he said, Mathline is based on the standards that were developed by the National Council of Teachers of Mathematics and it consists of a series of videotapes. There are four basic courses and they have anywhere from 12 to 24 videos.

Besides videotapes, there are printed lesson guides and also a facilitated on-line learning community that has developed where teachers can share ideas, they can ask questions and they can network with other teachers in the field, trying to improve their teaching skills.

The videos and the lesson plans were often distributed through local PBS affiliates, and that is where I initially got involved in this project. Each of these learning communities has a local facilitator that works with the group and establishes a comfortable on-line environment for sharing the ideas.

This year, in addition to these learning communities, PBS had expanded this to have a moderated national forum using PBS's website. Teachers can now download the lesson plans from their website, they can view snippets of the videos, and they can do this any time of day from any location where they have access to the Internet.

My involvement has been both as a facilitator in a local learning community, in Cincinnati, for the high school Mathline project and this year I am the moderator of the National High School Listserv.

And what I have seen over the several years is that many educators have found this type of staff development to be a very worthwhile tool. All the teachers that I have dealt with have felt the video lessons have been excellent. The videos use outstanding teachers, who use unique methods to introduce math concepts to their students. The opportunity for teachers to discuss, to share ideas from educators from their area and also now from educators across the country has been a very rewarding experience.

In my position as a district technology coordinator, what I have as the greatest detriment to staff development is time. We always have a problem with when to do this. And I think this is one reason that Mathline has been so successful, because now the teachers can view the videos, they can participate on-line any time of the day. They can do it from school, they can do it from home, they can do it from anywhere they have access to the Internet. Even veteran teachers have found this type of professional development to be very beneficial.

This year, working with the National High School Listserv, I have found that educators are excited about being able to share these ideas, not only with teachers around them but teachers from anywhere in the United States.

Obviously the biggest reward in this comes to the students. I have found when teachers have tried the instructional methods and

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lessons in their classroom, most have been rewarded with eager students.

You know, many teachers have told me when they watch the videos that my students are not like these students in the videos, but when they actually try the lessons, they are very surprised by the reaction the students give them.

All these lessons try to engage the students in the learning process. The students become active participants. They seem to comprehend the material and seem to retain what was introduced.

The hope obviously is that the teachers use these methods in other lessons and use these experiences with other math teachers in their building and also share it with other teachers on-line.

Obviously we are still a long way from having teachers feel comfortable with technology-based professional staff development. Teachers need technology training. They need to become aware of the valuable pool of information at the end of those wires.

Mathline is a great way for teachers to do this, so the service needs to expand; it needs to grow. Not only is it important to math teachers but also as a model for other numerous disciplines. I thank you.

[The prepared statement of Mr. Hogan follows:]

PREPARED STATEMENT OF DANIEL HOGAN

I would like to thank the chairman and the members of the committee for giving me the opportunity to be here today.

I would first like to give a brief snapshot of the PBS MATHLINE project. Fours years ago PBS responded to the national call for improvements in the way math is taught in U.S. classrooms. PBS launched the MATHLINE project with one simple idea: to spread quality instructional techniques quickly to mathematics teachers across the country. The ultimate purpose of MATHLINE was to help the nation reach its goal for mathematics education and achievement.

Through public and private funding, MATHLINE has developed four projects: The Elementary School Math Project for teachers in grades K-5; the Middle School Math Project for teachers in grades 5-8; the High School Math Project for teachers in grades 7-12; and the Algebraic Thinking Math Project for teachers in grades 3-8.

Each project consists of a series of video lessons, allowing teachers to view educators in the classroom, actually using teaching methods based on the new math standards. Each model lesson is accompanied by a comprehensive lesson plan and by suggested ideas for online discussion among teachers.

At first, the videos and lesson plans were distributed through what we call "learning communities," established through local PBS stations across the country. Each learning community had a local facilitator who worked with the group and led a Web-based forum for sharing ideas. This year, in addition to the local learning communities, PBS set up a national forum using the PBS Web site. Teachers now can download the lesson plans and sample the videos at any time of day, from any location. They have also established a national online forum for each project level to allow educators to share ideas.

My involvement has been both as a moderator of a local learning community in Cincinnati for the High School Math Project and as the moderator of the national High School Math Project online forum. What I've seen over the last several years is that many math educators have found this type of professional development to be highly worthwhile. All the teachers that I've dealt with have found the video lesson to be excellent. They feature outstanding teachers using unique methods to introduce math concepts to their students. It has been a valuable and rewarding experience to discuss the lessons and share ideas with educators from their area and across the country.

The greatest detriment to staff development, in my experience, is lack of time. This points to one reason why MATHLINE is so successful: Teachers can view the video and go online at any time. They can do it from school, at home, from anywhere. Even veteran teachers find this form of professional development beneficial. This year, working with the national High School Math Project online forum, I have found educators excited about sharing ideas with other professionals across the country.

The biggest reward, of course, is for students. Teachers who try these instructional methods in their classrooms are rewarded with more eager, more motivated students. Some teachers, at first, have said, "My students aren't like the ones in the videos." But then they've been surprised: These lessons engage students in the learning process. Students become active participants. They enjoy the lessons. They understand the material. They retain what is introduced.

Our purpose, of course, is for teachers to use these methods for other lessons and share their experiences with other math teachers—in their schools and around the country, online.

To me this type of professional development is just the beginning. As the project goes forward, we're learning how to make the technology easy to use and seamless. Now we need to make more teachers aware of this valuable tool. The exciting part of this project is that with the daily changes in technology, numerous teachers will find this to be a great device for helping them engage students in the learning process.

We are still a long way, of course, from having all teachers feel comfortable with technology-based professional development. Teachers need technology training; they need to become aware of what valuable tools and information are at the other end of those "wires!" This project is in its infancy, but it deserves to grow and expand. It's important to math teachers, and with your help, it can become a model for teacher training in other disciplines.

The CHAIRMAN. Now shall we have the presentation?

Mr. DUGGAN. Yes, sir. We are delighted to have from PBS Learning Ventures one of the editors of PBS Online, Lindsey Austin Samahon. She will lead us through a digital television package that was transmitted last November. When Ken Burns' documentary was broadcast, we packaged, we imbedded in the program additional signals, and people who are properly equipped could tune up this package that came along with the program as an additional learning resource. It gives us just a small glimpse of the almost magical potential of digital technology.

Lindsey? Let's give her a microphone, Senator.

Ms. SAMOHON. Well, I am pleased to be here with the you today and to demonstrate to you what we really believe is history, history that is going to change the landscape of education in the classroom, in the home and beyond.

So what I am going to demonstrate to you is what Mr. Duggan described, is the first digitally-enhanced content that was transmitted via broadcast with a television program.

What you are seeing here is the end of the program as our member stations and those who participated in this trial would have seen the day of the broadcast, the night of the broadcast. Here is the end of the show, and we are now moving into the credits. And you can see at the bottom that we have an invitation right here to extend our learning experience into an interactive environment.

And now what we are going to hear is the voice of Erick Lloyd Wright, an architect and the grandson of Frank Lloyd Wright.

You can now see that we have seamlessly moved into an interactive environment and we are going to get a little bit more information on how to get around.

Now we are going to enter into Falling Water. This takes us into a new type of environment and I have never been to Falling Water before, but we are going to take a little field trip there.

So we have followed the directions and we have clicked on a point in this blueprint, and using Ipix technology, we can take a 360 degree tour of this room, seeing what it might look like if we were actually there at Falling Water. We can zoom in for a closer look and we can zoom out.

Now Falling Water is three stories high, so we can either go to the second floor here or the third floor. And let's visit another room here. Here we are in the bedroom and you can see we can still take this beautiful 360 degree tour.

Now the fabulous component that really ties all of this into education is this button right down here that says "Teach." When I click on this, I am going to get a vast amount of educational resources that tie in the documentary, as well as this enhanced interactive experience, giving teachers, educators, lesson plans, discussion topics to use in the classroom, ideas for activities to use with their students.

Now let's go back to the main interface and we will next go to the Guggenheim, my favorite building.

Now you can see that we have entered into the front door of the Guggenheim. We are taking a 360 tour again. And we are going to next dive deeper into the content and enter into this area called "Reflections on spirals." And this is an exciting resource. It is basically a collection of video clips that you can explore at your leisure, clicking on any of these clips from the index below.

Now if I am not interested in the one that is playing, I can stop it and I can jump to another one and watch that one.

And down below here you see that we have some prompts of different opportunities that we can click on. Here I am getting an offer to allow me to bookmark some additional content and keep it on my website browser for later browsing if I choose to link onto the Internet. I am going to bookmark this and it is going to save it for me.

And now we will go down here and watch another additional video clip. We can dive even deeper into the content to see additional video clips. In this area again they are indexed and you can click on the one that you are interested in.

The nice thing about this one is the juxtaposition of video and slide, the kind of slide show as you are going through.

And headed back to the Guggenheim, we will head back to the walk-through. I wanted to point out again the slide shows that can go along with your tour.

All right, that concludes my demonstration. I would like to just show you how you exit this experience. All you do is quit. It is asking us if we, in fact, want to quit and we say yes, and then we can either return back to PBS Television, PBS On-line Website or go to one of the bookmarked sites. And we will go back to television.

Mr. DUGGAN. Senator, we are now capable technologically of packaging with every program that we send to the home or school an interactive learning package like this in different subject areas. The only bar is, of course, the bar of cost and the bar of training people to do this kind of content, but I hope you can see the tremendous potential of including with our programs materials that teachers can download into their computers or viewers, lesson plans and this tremendously enriching material. We appreciate the opportunity to demonstrate this today.

The CHAIRMAN. Well, thank you very much. It is fascinating.

I am a little confused. Where is all this stored? It is on a video cassette?

Mr. DUGGAN. It is like a CD-ROM. It is imbedded as part of the television signal. It can be downloaded into the home computer that is properly equipped.

We are moving to a point, Senator, where the television set, the computer and the telephone system will be converged into essentially one seamless technology. And you can just download this content into your hard drive when it comes into the home.

The CHAIRMAN. Well, thank you very much.

Dr. Miller.

Ms. MILLER. Good morning. I am here this morning to talk about program content and about professional development, kind of the other side of the PBS story in terms of dealing with young people.

I am the president of the JASON Foundation, which is the largest and, I think, the most credible science education program delivered by multiple technologies and by multiple delivery methods, including traditional kinds of teaching.

This morning I drank my coffee and read my newspaper, as most of you did. Six hours ago my son, who lives in Paris, woke up, took his cup of coffee, went over and switched on his computer to his personalized information page. He read the headlines from six different newspapers, going into particular stories, looking at scenes from Kosovo and probably from Colorado.

He read the business news, looked at different companies that he was interested in, looked at the weather in 10 different cities and certainly the sports news in the United States. He went into Reuters for stocks of interest, scanned the headlines, looked at a movie review in streaming video, and then he sent me a picture of my two-week-old new granddaughter. What a different world it is.

He tells me he feels as much at home, although he is very far away from his family. This is the world that today's children must know and must understand.

In each of your lives and in each of the lives of these children, I hope that there is a teacher who sees the potential deep within each child and makes him or her feel that confidence, that learning is not only the greatest adventure of their lives, but that it is really possible to be successful.

Teachers, and I cannot say this more strongly, teachers make the most essential difference in the lives of all children.

Less than 1 month ago, several millions of children, many of whom had never been more than five miles away from their homes, traveled to Peru through satellite, through streaming video, through the Internet, learning about snakes, learning about the rain forest and ecosystems, walking high in the forest canopy, swatting mosquitoes on the forest floor, and meeting Randy the Bug Man.

The 15,000 teachers who were involved in this expedition were all equipped to challenge their students with activities, have them do research, gather and share local data, speak to scientists on the Web, use scientific instruments and participate in an interactive dramatic three-screen presentation at a university, a museum, a school setting, somewhere around this country.

This is JASON, far beyond what any school of education or university in our Nation has been able to develop. JASON teachers have learned to integrate dynamic content into multiple technologies that our society offers today.

Teachers know that they are learning, along with their students, that they are participating in a program that is immediately current and, at the same time, really good science. These teachers understand the power of Bob Ballard, the founder of the JASON program and the moderator of the two-week experience to involve and excite students about scientific process and scientific discovery.

These teachers have come together on the Web and many are coming here together in Washington this day, this week, to participate in the growth of JASON, to help us figure out where we go from here, to participate in, I think, one of the most effective science programs that is available.

Let me introduce you to a third grade teacher from Wooster, OH, and I come from near Worcester, MA. She is also what we call a PIN network coordinator—Primary Interactive Network site—in Ohio. Georgene Lytle.

Georgene personifies what we think of when we say the word teacher and what we remember of the person who influenced each of our lives. She will demonstrate to you how JASON helps to use the technology not as an end, but as a tool that is going to help all of you sitting here learn content.

Georgene.

Ms. LYTLE. Thank you. I want to thank you for the opportunity to be here. This is really a thrill, to be able to talk about something that I feel so passionately about.

I have been a JASON teacher for 3 years now. I have also been the PIN site coordinator for my school system, which means that I have had the opportunity to organize the in-service for the teachers in my system and surrounding districts.

What I am going to take you through is a sample lesson, which focusses on what is really unique to JASON, the fact that JASON has a print curriculum, JASON also has video, which the culmination of, of course, is the live expedition, and JASON has a very extensive Internet site which allows students a variety of experiences on that site.

This year's JASON was the rain forest. We concentrated on comparative study of three different rain forests—the fossilized rain forest, the temperate rain forest and, of course, we ended up in Peru in the tropical rain forest. And when you think rain forest you automatically think biodiversity. And if you think biodiversity, you think, of course, insects.

Insects are the most biodiverse group of living things on our planet. There are more than 1 million insects that have already been identified; some estimate 20 to 30 million that need to be identified yet.

So I am going to turn to investigation 4.6 from the JASON curriculum, which is called, "What the heck are arthropods?" and go through it as I would with my third grade class.

What I would like my third graders to know are the basic differences in insects—what are arthropods, what are insects, what are arachnids, that sort of thing. I would start out by, first of all, taking my tube of bugs and laying them out and telling the children that these are all arthropods. But within the arthropod family we have insects and arachnids and millipedes and centipedes and some other things.

We are going to specifically concentrate, since this is eight-year-olds, on the difference between insects and arachnids. And through a series of questioning of my students and trying to find out what they know, so we know where to go from there. Most children will tell me yes, they know what an arachnid is, thanks to Hollywood and the movie "Arachnophobia"—they have all heard of that. That yes, they do have eight legs, and insects, by contrary, have six legs.

Then we would take our plastic insects and separate them out and have the children classify them according to how many legs they have, so this is real hands-on. They are actually looking at the legs, counting the legs, making separate piles of insects, and then making some further observations of those insects at that point.

Then we start talking about what things are common to all insects? Well, all insects have three body segments. All insects have six legs. And go through this whole series of things with the children as far as body parts, who has antenna, who has wings, what kind of eyes do they have, why might they need the kind of eyes that they have—a series of questions that really get the kids focussing on some higher level thinking skills.

In the meantime, we would pull in the JASON home page, which has fabulous connections to real insects from the Amazon, pictures that have been taken there. We have Randy the Bug Man Morgan, an Ohio scientist with the Cincinnati Zoo, who has done live chats with the kids during their study of insects. They will see Randy in the live expedition, so there is a tie-in there. We have an "Ask an Expert" program so that the children can get answers to their questions about insects over the Internet, all sorts of activities going on.

Finally, it is time to apply what you know. So now the children are going to become entomologists. They are going to go into the Amazon rain forest. They are going to discover a new insect. And what are they going to do with that information? Hopefully the same thing you are going to do.

There should be a white envelope in front of you, and in it you have some insect parts. And what you are going to do is you are going to be an entomologist and you are going to create an insect.

Now your insect can be whatever you want it to be. However, I stress it must be scientifically accurate. It must have the number of body parts and the number of legs that insects have.

At the same time I have also taken a similar activity, and I have some pictures to share, from my real third graders in Wooster, OH with a digital image of their little faces down here on the bottom, little entomologists that they are, and they have created some insects on a program, a software program.

So if you would like, you may create your insect. I did bring some that they have created, also. But this is a real hands-on thing for these kids. And I can tell you that my third graders know how many body parts an insect has and they know how many legs an insect has.

The follow-up to this is that they do go to the live broadcast, and during the live broadcast they meet Randy Morgan. They see a student argonaut with Randy Morgan. We actually had a student from our middle school at Wooster who worked with Randy in the Amazon, and they see him dealing with these insects that they have studied.

The CHAIRMAN. Excuse me. Unfortunately, we have a vote on right now.

Ms. LYTLE. Well, thank you very much.

The CHAIRMAN. We will be back or I will be back, anyway. We just have to take about five minutes.

[Recess.]

The CHAIRMAN. You can start bugging you again.

Ms. LYTLE. I can start bugging you again? Great.

Just in conclusion I would like to say that I think you can see the impact of something like this. The kids that have gone through a program like this definitely have learned science in a hands-on, real way. They have Internet to support it, real live scientists to support it. And JASON also encourages us to use scientists at our own local level, which we have been fortunate in Wooster where we have used the College of Wooster scientists and OARDC scientists. So it is a great program.

Ms. MILLER. What you have seen is just the beginning, an introduction to just one JASON topic. It is important that you understand that while students are truly enjoying themselves, the purpose is serious science and that every child in this Nation should have the opportunity to participate in a program, in any program annually of exploration and discovery, of exploration and inquiry.

Every child should know the wonder and the process of real science in action. Every teacher should be capable of bringing scientific inquiry into the lives of all of their students.

ESEA legislation must incorporate the image of what you see and what you hear today. We are not in the business of helping teachers to learn about technology. We are in the business of helping teachers to use technologies, to have their students understand content, stimulating inquiry from our young people through all of these tools, to develop their natural inclination for inquiry and discovery, to help them to ask questions, to help them find answers.

ESEA should be a supporting program. We have built a vast infrastructure in this country. If there is nothing to put on that infrastructure, all of the moneys that have been used so far have been wasted.

JASON has many supporters to thank: NOAA, particularly the National Underseas Research program;, NASA, who we will be working with next year while we go to outer space and inner space; EDS, a company that has given life and sustained JASON through its 10 years of operation. Bechtel, SPRINT, Westco, National Starch, Exxon, Tenneco, National Geographic—all models of corporate public cooperation. We are grateful for the new Federal initiatives of the Technology Literacy and Innovation Challenge Grants and teacher partnership opportunities.

And particularly, and no one has mentioned this yet today, particularly the Star Schools legislation, which blazed a trail for interstate cooperation in technology programming that no other program has ever equalled or tried to develop. For the first time this year, JASON is applying for a Star Schools grant—maybe that is why the plug—to begin incorporating the next generation of technologies. We should always be thinking ahead, not rushing to try to catch up.

We are looking at curriculum using web radio, wireless video, hand-held independent devices, programmable bricks from MIT, virtual reality. All these things are just on the horizon.

At the same time, it is necessary that you realize we are living in a global society that has to benefit from the research of others, that must use the research of others, that the purpose of Federal initiatives in technology is to provide models, good models to improve the mastery of skills and content.

When Bob Ballard discovered the Titanic, he awakened the imagination of millions and millions of children and adults. However, his legacy is not the discovery of the Titanic. His legacy will be the birth of JASON. May you who have the power to develop our teachers and to develop educational opportunities for our students recognize that your legacy, the legacy of every senator on this committee, will be in the accomplishment of a society that builds educational excellence, that treasures the past but is ready to accept the challenges of today and all the promise of tomorrow. Thank you.

The CHAIRMAN. Thank you, Doctor.

Mr. Pitroff.

Mr. PITROFF. Thank you and good afternoon. I am pleased and honored to have an opportunity to come before you and discuss one of the Baltimore City Public Schools' technology initiatives.

I am the director of instructional technologies library and media services for the Baltimore City Public Schools and the principal investigator of our Technology Innovative Challenge Grant, which we were awarded in 1995. Our challenge grant is consisting of two major components. One is a partnership that we have with Discovery Learning and the University of Maryland at College Park, which is a collaborative teaching project which is bit-streaming video on demand to our teachers' desktop.

And the other major component is a partnership that we have with the Johns Hopkins University Center for Technology and Education in their SCANS 2000 Center, which we are looking at in terms of putting the school to work on the information superhighway, and that is what I am here to discuss with you this morning in terms of our school-to-work initiative.

We are presently engaged in many workplace simulations in our pilot schools that we are implementing in our particular project. Success is evident through increased competencies of both our teachers and students in the use and applications of technologies. Moreover, students and teachers are bridging the gap between what is learned in school and its application to the world of work.

This morning I would like to emphasize four points. Is the project working in our schools and how do we know? What will be the real successes and how will we be able to know those? What are the barriers to success and how will we overcome them? And what is needed to maintain and expand our program so it becomes a part of systemic efforts in Baltimore, as well as other urban and rural schools throughout the Nation.

Our project appears to be working in our schools. Through evaluation models and surveys and feedback and demonstrated competencies, we have been observing that the overwhelming majority of our teachers have indicated to us that they have had an opportunity to increase their skills in the use and applications of technologies, as well as their content pedagogy.

Teachers are using real-world context and performance assessments more frequently than in their traditional classrooms. Teachers' abilities to collaborate among each other and team with others and be able to apply what they have learned to improving their teaching is on the increase. The teachers are strongly indicating that what they are applying and what they are learning in our project, they are actually dealing with and looking into other classrooms that they are actually working with and teaching.

Our students agree that the program is helping them improve in their writing skills and making presentations. Over 85 percent of our students indicate that the program has helped them to understand how to use math and to solve real-world problems and to get better grades within their environments.

Close to 90 percent of our participating students indicate that the program is helping them to increase their commitment and interest in school, as well as to develop the skills that they will need on the job.

Finally, 93 percent of the students indicated the program was helping them understand computers and the use and applications of the technologies that we are actually putting in front of them.

I should note that this did not happen quickly. When are in our fourth year. We have another year to go and things are moving along slowly, just like systemic initiatives do. It requires acquiring and deploying technology, considerable change in teaching and learning styles, faculty development, and vigorous support from the principals, the community, and other administrator.

We are examining whether or not this program increases student attendance, grades in math and English, and the mastery of selected workplace skills.

In the coming years, Maryland's students will be involved with high school assessment programs where they will need to demonstrate skills for success which are reinforced and identified in the Secretary's Commission on Achieving Necessary Skills, the SCANS report.

How we defined our real successes. The goals in the Baltimore City Public Schools can be summarized as preparing all students for successful careers and to be able to further their education. This project is seen as helping to deliver those two ends. By the project's conclusion in September of 2000, we will have a good idea of the extent that this approach has actually contributed to systemic high school reform within Baltimore and within the schools that we are actually working with.

Our evaluation will try to answer the key question: Does the project lead to institutional change? Will the innovation continue and will our students leave high school prepared for careers and to be able to further their education?

Currently, the following events have occurred. Teachers were trained in the following areas to support the full integration of the school-to-work system, overview and integrating the SCANS competencies and technologies into their existing content courses, implement project-based learning modules and how they support the full integration of technologies and the use in their classrooms, using technology applications as instructional, multimedia and productivity tools, and assessing distance learning technologies to be able to collaborate with the larger business community at large, as well as collaborate among schools in developing and presenting lessons.

Students are increasing their use of technology and their masteries of the technology. They are working with work-based assignments. They are increasing their knowledge of the skills that are needed for the world to work. And they are gaining tremendous insight into career opportunities that are available in the industries of tourism, retail, and the health-related fields.

Some of the barriers that we have come across in all of our technology implementations are pretty consistent. Some of the ways that we are able to use the Technology Challenge Grant to overcome them I would like to highlight.

Through some of the experiences that we have had, we have noticed that episodic reform efforts have not and will not produce changes that are needed to bring high school students to the point where they can meet high standards. Too many fragmented episodes do not lend themselves to systemic change, so we took a different approach.

We took the approach where we had to have full community and school buy-in to this project to it, where we were systemically implementing these particular programs and initiatives within the schools, hopefully within the small learning communities that we have established within our buildings that expands to the larger high school reform effort.

Our students had limited and our teachers had limited access to technologies, the support needed in order to implement technology and to maintain them, and the need for staff development in order to support that. The challenge grant afforded us the opportunity to be able to bring the technology infrastructures into our schools that we needed in order to teach the appropriate school to careers and the technology skills that we needed, as well as building in the support structure that the Baltimore City Public Schools needed in order to implement this program within our selected high schools.

The biggest obstacle that we come across in terms of our reform effort here has been the rigid traditional high school content and scheduling pieces that we had to undertake. We were trying to establish small learning communities. Our teachers are used to standing up in front of a classroom and delivering content in a very lecture-oriented mode. We were changing the whole way that our teachers were doing business.

Our teachers are now collaborating, they are teaming, they are building small learning communities within their structure. Cohorts of teachers are collaboratively planning and using technologies together. Student cohorts are being implemented and scheduled so that the teachers have access to them when they need them. And the consensus among staff for building small learning communities in the academy structure within our schools is being done.

Another obstacle that we have overcome has been looking at making learning meaningful for students in our high schools. Students are our primary workers in this system. Especially by high school, they want to know that what they are learning has meaning. They want to know that the tests that they are taking and the diplomas and the certificates that they earn count for something beyond the school walls.

As a result, we have developed three learning modules that simulate activities in the fields of tourism, retail business, and the health field, and the focus on the learning modules are to implement the SCANS competencies and the core content areas; moreover, to bridge the gap between school and work. If subject matter is dull, success is difficult.

So through the implementation of our CD-ROMs and the use of our application technologies, our students are analyzing, researching and synthesizing data through the use of technology. Teachers are using these CD-ROMs to extend class periods to provide learning activities that foster higher-order competencies and build better subject area expertise.

Students use the computer and the Internet on a daily basis. They work in teams to learn academic, career and interpersonal skills.

Assessments must also be addressed. We have altered and extended beyond the traditional multiple choice testing environment. An Internet-based Career Transcript based upon the SCANS has been developed. This Career Transcript that we are having our kids involved with is a living document that remains with the student, documenting his skills or her skills attained by further schooling and in the workplace environment. We hope this encourages life-long learning for each of our students. We know that what is not measured is rarely done and what is not tested is rarely learned. The Career Transcript is intended to overcome that barrier.

Inadequate staff development and teacher support and training has also been an obstacle that we have come across in terms of implementing technologies. The new curriculum and instructional strategies and technologies put demands on our faculties and our teachers. Teachers must learn how to use these technologies to create new learning environments in which students use technology and work in teams to solve problems and product products. Successful high school reform is going to depend upon teachers and administrators who will reliably implement positive changes toward student learning.

To that end, we have implemented two staff development initiatives through this grant. One is what we call TeamTech Learning to support collaborative team-building and project-based learning, which addresses staff development at the teachers' need level, whether it be technology, content-based, or collaborative learning and teaching strategies that they need.

The other is an on-line mentoring program that we have put in place to help our teachers in an anywhere-anytime environment where it is Web-based, where they can get information, they can talk with their peers, they can talk to the community, they can talk to anyone else that they need to in order to develop any mentoring skills or any additional skills that they have.

The final obstacle that we have come across in terms of the implementation of these projects is the connection with the outside world. Through the connections that we have made in our literacy grant, this has been a primary focus of establishing partnerships and connections with not only the parents and the larger school community but the business communities, as well. And many of our partners are assisting us to make the school-to-career and the school-to-work a successful project by businesses actually working and partnering with us and looking at and analyzing the students' work and then giving them feedback on a daily basis.

Our goal is to reform learning so that young people are prepared for further education and careers. Our project, Putting Schools to Work on the Information Highway, shows promise, but promise has to be sustained and expanded. That will cost money.

Resources are needed to carry out the seven steps that I have just outlined—to articulate and communicate a strategic vision; to acquire, install, and maintain technology; to organize the school and adjust class scheduling; to provide materials and the environment for projects that students and employers find relevant; to accept new methods of instruction and assessment that provide students with a Career Transcript that employers will value, with an academic transcript that most postsecondary institutions will honor; to develop teachers who can use these tools in project-based collaborative learning; and involve parents, employers, and others in the community in order for us to make success.

Federal funding has proven to be the most valuable source of funding for the Baltimore City Public Schools in initiating any technology initiatives. We fall short in terms of the local dollars that we get in order to support the implementation and the applications of technology in Baltimore.

Through the Technology Learning Grant and the Technology Learning Funds, that has been primarily my main source of dollars that we needed to implement any of our technology issues. And Federal funding remains the promise for us for the future in terms of implementing and supporting our technology. And I thank you.

[The prepared statement of Mr. Pitroff follows:]

PREPARED STATEMENT OF MICHAEL PITROFF

Good Morning. I'm pleased and honored:

I am the Principle Investigator and Director of the Baltimore Learning Community Innovative Technology Literacy Challenge Grant. The Baltimore Learning Community consists of two major components. A partnership with the University of Maryland at College Park and Discovery Learning to implement a collaborative teaching state-of-the-art video on demand initiative. The other component is a partnership with the Johns Hopkins University, Center for Technology in Education and the SCANS 2000 Center to implement Putting School to Work on the Information Highway.

Today, I will be discussing the School to Work project. This project is in its fourth year and over 200 students are presently engaged in workplace simulations. The Baltimore Learning Community has grown from one to five schools over the period of four years. Success is evident through the increased competency of both teacher and student in their knowledge of technology. Moreover, students and teachers are bridging the gap between what is learned in school and its application to the world of work.

I would like to emphasize four points:

1. Is the project working in the pilot schools and how do we know?
2. What will be real success and how will we know?
3. What are the barriers to success and how we have overcome them?
4. What is needed to maintain and expand the program so it becomes part of a system-wide solution for Baltimore and other urban school systems?

THE PROJECT APPEARS TO BE WORKING IN THE PILOT SCHOOLS

We have reason to believe it is working. At the moment we have survey data from teachers and students.

82% of our teachers indicated they have the opportunities to increase their skills.

Teachers use the real-world context and performance assessments more frequently than in traditional classrooms.

Teachers' ability to collaborate and team with others and be able to apply what they have learned to improving their teaching is on the increase.

Close to 90% of the teachers strongly or somewhat agreed that they are working in a stimulating environment.

Over 80% of our teachers indicated they were applying what they were learning in their classrooms.

Participating students also assessed the program.

Over eighty percent agreed that the program helped them improve their writing skills and making presentations.

Eighty-five percent indicated that the program helped them understand how to use math to solve real problems and to get better grades.

Close to 90% of the participating students indicated the program was helping them increase their commitment and interest in school as well as develop the skills they will need on the job.

Finally, 93% of the students indicated the program was helping them understand computers and use technology.

I should note that this did not happen quickly. It requires acquiring and deploying technology, considerable change in teaching and learning styles, faculty development, and vigorous support from the principal and other administrators.

We are examining whether the program increases student attendance, grades in math and English, and mastery of selected workplace skills.

In coming years, Maryland's students will be asked to demonstrate acquisition of "Skills for Success," which are reinforced and identified in the Secretary's Commission on Achieving Necessary Skills (SCANS).

DEFINING REAL SUCCESS

The goals of the Baltimore City Public School System can be summarized as preparing all Baltimore students for successful careers and further education. This project should be seen as directed to these two ends.

By the project's conclusion, in September of 2000, we will have a good idea of the extent that this approach contributes to systemic high school reform. Our evaluation will try to answer the following key questions: Does the project lead to institutional change? Will the innovation continue and will students leave high school prepared for careers and further education?

Currently, the following events have occurred with the introduction of this initiative:

Teachers were trained in the following areas to support the full integration of the school-to-work system:

Integrating SCANS competencies and technology into existing courses.

Implementing project-based learning models and how they support the full integration of technology into the class.

Using technology applications as instructional, multimedia, and productivity tools.

Accessing distance learning technologies that are used as tools to train both teachers and students.

Students

Increasing their use of technology.

Enjoying and understanding the need for work-based assignments.

Increasing their knowledge of the skills that are needed in the world of work (SCANS).

Gaining tremendous insight on the career opportunities that are available in the industry of tourism and retail.

THE SEVEN BARRIERS AND SOLUTIONS TO SUCCESS

Our experience has identified seven barriers to success and how our project has overcome and addressed them.

1. Fragmented episodes: Episodic reform efforts have not and will not produce the changes needed to bring high school students to the point where they can meet high standards. Too many episodes, reflecting too many separate projects, produce fragmentation.

Our solution was to institute systemic change to sustain efforts of the high school reform initiative. This change involved collaboration among the administrators, faculty, and the community in each of our schools.

2. Limited Access to Technology: Limited amounts of computers, networks, software, and Internet access were our main technological challenges. In addition, support for school-based technical problems and needed staff development were lacking.

A substantial portion of the Challenge Grant we received for "Putting School to Work on the Information Highway" was used to build the needed technology infrastructure.

3. Rigid school organization and scheduling: The biggest barrier to implementing the school-to-work initiative is the traditional high school structure and scheduling. In addition, an adequate amount of collaborative planning time for teachers to create cross- disciplinary units was lacking.

The following components are critical to insure the success of our initiative:

Identification of a teacher cohort that is comprised of teachers from all disciplines.

Identification of a student cohort.

Acceptance of the integration of SCANS competencies and technology into the existing curriculum.

By building consensus among the staff for the academy structure and scheduling the cohorts of students and teachers, we have modified the school's traditional organizational structure to increase the success of the project.

4. Making Learning and Assessment Meaningful? Students are the primary workers in the system. Especially by high school, they want to know that what they learn will have meaning. They want to know that the tests they take and the diploma and certificates they earn count for something beyond the school walls.

As a result, we have developed three CD-ROM learning modules that simulate activities in the fields of tourism, the retail business, and the health field. The focuses of the learning modules are to implement SCANS competencies and core content areas; moreover, bridge the gap between school to work.

5. Weak traditional curricula and pedagogy. If the subject matter is dull and boring success is difficult.

Through the implementation of the CD-ROM modules students are actively analyzing, researching and synthesizing data using technology.

Teachers use the CD-ROM's in extended class periods to provide learning activities that foster higher order competencies in basic subjects.

Students use computer and Internet technology. They work in teams to learn academic, career, and interpersonal skills.

Assessments must also be altered and extended beyond traditional multiple-choice tests. An Internet-based Career Transcript based on SCANS has been developed. The Career Transcript is a living document that remains with the student, documenting skills attained by further schooling and in workplace learning. We hope this encourages lifelong learning.

We all know that what is not measured is rarely done and what is not tested is rarely learned. The Career Transcript is intended to overcome this barrier.

6. Inadequate Professional Development and Support. The new curriculum, instructional strategies and technologies put new demands on faculty. Teachers must learn to use technology to create new learning environments in which students use technology and work in teams to solve problems and produce products, as they will be expected to do in the workplace. Successful high school reform depends upon teachers and administrators who will reliably implement positive changes to improve student learning.

TeamTech Learning to support collaborative teams building and project-based learning has been developed.

Teachers are trained to develop technology-rich, project-based instruction. A "three-tiered" approach to train teachers who are at different levels of technology competence, from beginner to advanced, is utilized. This ensures that virtually any teacher will be able to apply the principles of project-based instruction and collaborative team building in technology-rich environments.

On-line Mentoring to Support Ongoing Professional Development: The Electronic Learning Community. The web-based Electronic Learning Community (ELC) provides that kind of "anywhere, anytime" support. The ELC offers teachers dynamic resources for information exchange and technical assistance. Discussion forums and chat rooms bring teachers together to share lesson plans and other information for the successful implementation of the TeamTech Learning instructional strategies.

7. Little connection to the outside world. Parents, community, and employers are often absent from the picture.

Students will succeed in high school to their highest levels if families and communities support and encourage student attendance, high quality schoolwork, and clear plans for the future. For School-to-Career, it is especially important to have employers participate. We have had employers evaluate student products (such as the travel brochures) and have partnered with the Maryland Business Roundtable. Parents are actively involved in the students' final presentations of the project.

VIABILITY AND EXPANSION

The goal is to reform learning so that young people are prepared for further education and careers Our project, Putting School to Work on the Information Highway, shows promise. But that promise has to be sustained and expanded. That will cost money. Resources are needed to carry out the seven steps to success; that is to:

Articulate and communicate a strategic vision.

Acquire, install, and maintain technology.

Organize the school and adjust class scheduling.

Provide the materials and environment for projects that students and employers find relevant.

Accept new methods of instruction and assessment and provide students with a Career Transcript that employers will value along with an academic transcript that post-secondary institutions will honor.

Develop teachers who can use these tools in project-based collaborative learning.

Involve parents, employers and others in the community.

FEDERAL SUPPORT FOR TECHNOLOGY IN SCHOOLS

Federal funding has proven to be the most valuable source of funding for technology initiatives in the Baltimore City Public School System. Schools have made significant progress through initiatives such as the Innovative Technology Challenge Grants and the Technology Literacy Challenge Fund (TLCF). The development of the Baltimore Learning Community through funding of the 1995 Innovative Technology Challenge Grant is starting to significantly alter the ways our students learn and our teachers teach in several participating schools. The 1997 Technology Literacy Challenge Fund allowed our system to provide Internet access to all of our schools. The 1998 Technology Literacy Challenge Fund is providing at least one modern multimedia computer system in the media centers of all of our schools. These are small but significant steps toward building an effective technology infrastructure that can improve the way that we deliver instruction to our students.

State funds have been helpful in building a technology infrastructure in some of our schools. During the last 3 years, the Technology in Maryland Schools (TIMS) program will have completely wired 21 of our schools for voice, data and video. This is progress but in a school system of 183 schools it is unacceptably slow progress. Since this program requires local matching funds, our school system has not been able to take full advantage of the program. This year we were only able to participate in this program as a result of E-rate savings. If we continue to wire our schools at the current pace our schools will not be completely wired until 2015. There will continue to be generations of inner city students that will not have access to the technological resources they need to survive in the 21st century.

Local funds are generally not being identified to support technology initiatives. We have not had any local funding of instructional technology initiatives for over five years. In allocating capital improvement funds we are forced to choose between fixing furnaces and replacing roofs or wiring schools for technology. In allocating curriculum funds we are forced to choose between buying textbooks or buying software. In allocating instructional funds we are forced to choose between hiring teachers or buying computers. In a system with very limited resources, technology initiatives are consistently shortchanged.

Federal funding remains the best hope for improving technology in our schools. These funds needs to be allocated directly to local school systems and not passed through state allocations. Our school system has lost significant funding in the Technology Literacy Challenge Grant because of the way the state distributes the funds. A student identified in poverty in one Maryland subdivision receives $163 while a student identified in poverty in Baltimore City receives only $6 through the allocation of TLCF by the Maryland State Department of Education. This type of discrepancy in funding further handicaps our efforts to improve technology in our schools.

Thank you. I will be glad to respond to any questions you may have.

The CHAIRMAN. Thank you.

Dr. Gonzales.

Ms. GONZALES. Thank you. Thank you, Senator Jeffords, for inviting me to testify today. It is a great honor for me. This committee, especially Senators Bingaman, Kennedy, Murray and Jeffords, has a long record of supporting Federal educational technology initiatives.

My name is Carmen Gonzales and I currently serve as the project director for a State-wide professional development project called Regional Educational Technology Assistance or to RETA Program, as we call it, which was recently funded through a U.S. Department of Education Technology Innovation Challenge Grant. I will discuss this program today and the impact it has had on the State of New Mexico's educational community.

First I would like to give you a little background on New Mexico. It is a minority-majority State with a school population of about 48 percent Hispanic, 39 percent Anglo, 10 percent Native American, 2 percent African-American and 1 percent Asian. The State drop-out rate is 7.8 percent, compared nationally to 4.2. And 21 of our districts out of 89 have a drop-out rate higher than 8 percent.

Although minority students are at greatest risk, one in every four children in New Mexico lives in poverty and one in every three students in the school receives daily free lunch. These children are in greatest need of developing the skills needed to carry them through an education that prepares them to fulfill their potential and ultimately secure and maintain productive employment in the 21st century.

An engaging curriculum, enhanced by technology, taught by well prepared teachers familiar with the modern workplace, is crucial for New Mexico's students in schools, the primary places in many students' lives where they will have access to technology.

I am focussing on New Mexico but it does have a national interest. Much of our State's urban population is centered in three towns, and in these areas there are some opportunities for technology training and support. However, teachers in remote areas of this large, predominantly rural State do not have easy access to the training and support required to help their students learn to use computers and access the world's resources via this technology.

The public schools increasingly have become important as the critical path, for many, the only path for experiencing the ever-changing technologies of the outside world. Students in New Mexico school districts rely upon the availability of technology in their schools. Fewer than 17 percent have access to it in their homes. And although technology is slowly arriving in our schools through Federal funding, E-rate, the most critical link in this chain, professional development, is still a weak one.

The funding that this committee provides for educational technology helps to ensure equitable access to technology for teachers and students, both in our State and nationally.

Data from the Educational Testing Service indicates that 98 percent of U.S. classrooms have computers, but only 15 percent of teachers have been trained in their use. In New Mexico, no more than 4 percent of available State technology funds have been designated for teacher training, well below the national average of 9 percent and far below the recommended 30 percent.

While New Mexico teachers have had limited access to professional development resources due to both the great geographical distances and infrequent opportunities, the infusion of the Technology Literacy Challenge funding has resulted in increased professional development opportunities. District proposals reflect at least 30 percent of available funding for professional development.

I am going to give you a little background on our program. In 1994, the New Mexico legislature passed the Technology for Education Act that established a Council for Technology and an Educational Technology Bureau in the State Department of Education. This funding was directed toward helping school districts begin to implement local plans and toward building the technical and human infrastructure needed to achieve the goals of a State plan. The council developed the State plan and the districts needed to develop their own.

Funding was set aside for 1 year to begin a regional support network that would be responsive to professional development needs. These moneys, in part, paved the way for the development of the Regional Educational Technology Assistance Program.

So RETA began in 1995 under the direction of Los Alamos National Laboratory with $40,000 from the State legislature and we focussed on technology planning.

The next year, 1996-1997, we received $43,000 from the State's NSF State systemic initiative. And the program's focus shifted from working with technology planning toward developing a deeper and more meaningful understanding of how to use technology for teaching and learning. For this new focus, the RETA model used research that suggests teachers learn best from skilled peers, using exemplary curriculum models that can be adapted for local use and supported by a network of professionals who understand adult learning in educational systems.

In year three, 1997-1998, the RETA program obtained funding at $100,000 through the State's Technology Literacy Challenge Grant. We had one State-wide professional development project. Teacher workshops continued and a new component, the Leadership Academy for Administrators, was added. After looking at the program's first year, we realized that teachers can change just so much, but without support from their administrators, they were not going to be able to move forward.

The leadership academy centered on key topics identified by New Mexico districts as their most important issues: funding inequity, student learning, professional development, and curriculum integration.

Now this year, our fourth year, we were awarded an $8.7 million U.S. Department of Education Technology Innovation Challenge Grant. That is for 5 years. This year we received $1.5 million. It was awarded through the Gadsden Independent School District, in partnership with New Mexico State University's College of Education.

Up until this time, RETA had established a noteworthy track record with limited funding and resources. By building on this solid foundation, RETA is now well positioned to enhance and expand the existing network by including more teachers and administrators and by equipping them with the tools and infrastructure they will need to effect long-term sustainable technology-based educational reform in their districts.

We have five focus areas: professional development of preservice and in-service teachers, and the in-service happens throughout the State We have 45 teacher instructors who deliver the workshops in the teachers' districts. Advocacy development of administrators and policymakers, because in order to see real change, we have to involve them. Development of regional resource centers at institutions of higher education. We want to regionalize this throughout the State, so we have three institutions of higher ed besides ourselves. And curriculum development and dissemination on the Web. We are developing curriculum that is available in on our Website that meets with content standards and benchmarks for our State and nationally.

And the RETA philosophy emphasizes curriculum integration, rather than the technology. Teachers participating in the professional development workshops benefit from a series of six workshops, at least six—some have more—that allow them to begin at their own skill level and progress over the course of the academic year.

RETA instructors work in pairs to deliver the workshops, thus providing additional individual attention for groups that have mixed skills. RETA instructors are practicing educators who help identify new instructors from a current pool of candidates who have recently completed the RETA instructional sessions. By developing teachers within the districts to become RETA instructors and building teams of teachers within districts who share the knowledge and skills to integrate technology to support educational goals, RETA is developing the capacity of New Mexico's schools and districts to maintain their understanding of learning technologies.

RETA focusses on the development and leadership needed in schools to take full advantage of the technological infrastructures that are both present and planned.

The program evaluation findings to date indicate that RETA has met and, in many cases, exceeded expectations by providing a core team of peer educators skilled in providing technology integration workshops for classroom teachers State-wide, a State-wide network of peers capable of providing continuing support, a State-wide network of educators at the regional resource centers to assist with technology and planning, peer workshops on how to integrate technology to support educational goals, exemplary curriculum models adaptable for K-12 classroom application available on the Web, administrative leadership in educational technologies and professional development, and communities of learning where skilled educators share their knowledge to promote student learning.

Our evaluators for the project are from the Center for Children and Technology and they are very experienced in evaluating technology integration efforts throughout the country. They will incorporate multiple methods of data collection in order to evaluate this program.

RETA achievements have not gone unnoticed. RETA was selected by the Council for Chief State School Officers as one of three outstanding national projects. And one of the reasons it was was because it really is a replicable model, and we have also presented it at a number of different institutes and conferences.

New Mexico has made incredible progress since 1995 in developing the hardware infrastructure. The State has invested $17 million and we are estimating that local communities have come up with $50 million to develop to develop the technical infrastructure in the local districts.

The RETA Professional Development Initiative has helped to address the capacity-building in the State by providing a platform to seriously address curriculum and policy issues. Over the past 3 years, RETA has provided professional development opportunities in all but five of New Mexico's 89 districts.

In my written testimony there are some stories about what some of the participants are doing, but I will not go into that now. While there are many stories to share about RETA, I would like to mention the impact RETA has had on the State's Technology Literacy Challenge Grants awarded to districts for technology funding. That is the block grants that come to the State and then an RFP goes out.

At least 75 of the districts with successful grant proposals are those that have been initiated and written by participants from RETA. When they return from the RETA workshops, they become aware of their district's need for more technology and have taken the initiative to write the proposals.

I would like to close my testimony with a quote from one of the RETA participants. "I just need more, much more, and so do others who could not attend the RETA workshops. There is so much to learn and share. We just need more instruction, more opportunities to share, and more time to teach what we are learning."

On a personal note, I would especially like to thank Senator Bingaman, my senator, for leadership in Federal educational technology programs. The 1994 legislation, the Technology for Education Act, was the first major source of dedicated Federal funding for education technology.

Since its introduction, educational technology programs have grown substantially nationwide. They are a major cornerstone to education reform efforts, teacher quality initiatives and drop-out prevention programs. I encourage the Congress to continue and augment its support of educational technology for the betterment of America's schools. Thank you.

[The prepared statement of Ms. Gonzales follows:]

PREPARED STATEMENT OF DR. CARMEN GONZALES

Thank you, Senator Jeffords and Members of the Committee for inviting me to testify today, it is a great honor for me. This committee, especially Senators Bingaman, Kennedy, Murray, and Jeffords has a long record of supporting federal educational technology initiatives. My name is Carmen Gonzales and I am a faculty member at New Mexico State University in the College of Education and currently serve as the Project Director for the Regional Educational Technology Assistance (RETA) Program, recently funded through a US Department of Education Technology Innovation Challenge Grant. I will discuss this program today and the impact it has had on the state of New Mexico's educational community.

Background of New Mexico

First I would like to give you some background information on New Mexico. New Mexico is a minority majority state with a school population of about 48% Hispanic, 39% Anglo, 10% Native American, 2% African American, and I% Asian. The state drop?out rate is 7.8% (compared nationally to 4.2%) and 21 districts (of 89) have a drop-out rate over 8%. Although "minority" students are at greatest risk, one in every four children in New Mexico lives in poverty, and one in every three students in school receives daily free lunch. These children are in greatest need of developing the skills needed to carry them through an education that prepares them to fulfill their potential and, ultimately, secure and maintain productive employment in the 21st century. An engaging curriculum, enhanced by technology, taught by well-prepared teachers familiar with the modem workplace is crucial for New Mexico students since schools are the primary places in many students' lives where they will have access to technology.

Much of our state's urban population is centered in three towns: Albuquerque, Las Cruces, and Santa Fe; in these areas there are some opportunities for technology training and support. However, in the small towns and tiny villages, on the Indian reservations, and across the sparsely populated desert, resources are scarce. Teachers in remote areas of this large predominantly rural state do not have easy access to the training and support required to help their students learn to use computers and access the world of resources via this technology.

The public schools increasingly have become important as the critical path—for many the only path—for experiencing the ever-changing technologies of the outside world. Students in New Mexico school districts rely upon the availability of technology in their schools (fewer than 17% have access to technology in their homes) and the wisdom and skill of their teachers to use this technology in meaningful learning.

Although technology is slowly arriving in schools (in 1994 the state reported a 12 to 1 student to computer ratio, and in 1999 the ratio is now 7 to 1) the most critical link in this chain, professional development, is still a weak one. The funding that this committee provides for educational technology helps to ensure equitable access to technology for teachers and students both in our state and nationally.

Both internal and external funding for computer technology in public schools typically has provided monies for purchasing hardware and software, leaving few dollars for training. Data from the Educational Testing Service indicates that, while 98% of all U.S. schools have classroom computers, only 15% of teachers have been trained in their use. In New Mexico, no more than 4% of available state technology funds have been designated for teacher training, well below the national average of 9%, and far below the recommended 30% (Office of U.S. Senator Jeff Bingaman, 1997; Office of Technology Assessment (OTA), 1995). While New Mexico's teachers have had limited access to professional development resources due to both the great geographical distances and infrequent opportunities, the infusion of the technology literacy challenge funding has resulted in increased professional development opportunities. District proposals reflect at least 30% of available funding for professional development.

Most New Mexico teacher preparation programs do not provide relevant, comprehensive technology integration in their content instruction for preservice teachers. As a result, many new teachers graduate with a limited knowledge of the ways technology can be used in their professional practice. It is critical that colleges of education lead the way in preparing tomorrow's teachers to integrate technology into their teaching (OTA, 1995; National Council for Accreditation of Teacher Education, 1997).

RETA Background

In 1994 the New Mexico Legislature passed the Technology for Education Act that established the NM Council for Technology in Education (NMCTE). The NMCTE advises the State Board of Education, the Legislature, and the State Department of Education on issues related to the full implementation and integration of educational technology in support of teaching and learning, and establishes overall funding requests based on local needs. The Act also established funding for a new unit, the Educational Technology Bureau, in the State Department of Education. This funding was directed toward helping school districts begin to implement local plans, and toward building the technical and human infrastructure needed to achieve the goals of a state plan.

The Council developed the state plan to integrate technology into public schools in support of local, state, and national goals. This plan Roadmap to School Improvement, was adopted by the State Board of Education in June 1995 and submitted under ESEA, section 3133. Funding was set aside for one year to begin a regional support network that would be responsive to professional development needs. These monies, in part, paved the way for the development of the Regional Educational Technology Assistance (RETA) Initiative.

RETA began in 1995 under the direction of Los Alamos National Laboratory with $40K from the state legislature. Results of an initial needs assessment indicated that districts most needed help with their technology planning. Therefore, approximately 40 teachers End technology coordinators throughout the state were selected to help districts develop, implement, and assess their technology plans.

To build upon this initial network, $43K was secured in year 2 (1996-1997) through the state's NSF-funded State Systemic Initiative. These funds were leveraged with additional Los Alamos National Laboratory funds and the collaboration of New Mexico State University and the University of New Mexico to provide teacher workshops throughout the state. The program's focus shifted from working with technology planning toward developing a deeper and more meaningful understanding of how to use technology for teaching and learning. For this new focus, the RETA model used research that suggests teachers learn best from skilled peers, using exemplary curriculum models that can be adapted for local use, and supported by a network of professionals who understand adult learning and educational systems.

In year 3 (1997-1998), the RETA Initiative obtained funding at $100K through the state's Technology Literacy Challenge Grant. Teacher workshops continued and a new component, the Leadership Academy for Administrators, were added. The Academy was a partnership between the State Department of Education, NMCTE, New Mexico schools, the Center for Children and Technology (CCT), and the Milken Family Foundation. The Academy centers on key topics recently identified by New Mexico districts as their most important issues, i.e. funding and equity, student learning, professional development, and curriculum integration.

In year 4 (1998-1999) the RETA Program was awarded an $8.7 million Technology Innovation Challenge Grant through the Gadsden Independent School District in partnership with New Mexico State University's College of Education. As a successful collaboration of partnerships, with strong and consistent support from the New Mexico State Department of Education, New Mexico Council on Technology in Education, and New Mexico State University, RETA had established a noteworthy track record with limited funding and resources. However, until now, RETA has not been able to reach a critical mass of skilled educators and to establish networks needed to ensure long term sustainability. By building on a solid foundation RETA is now well-positioned to expand the number of educators receiving professional development, to continue the opportunities to acquire more advanced understanding, and to establish the capacity of NM districts to provide independent, substantial and ongoing professional development. Specifically, the NM Technology Innovation Challenge Grant/RETA Program will provide funding to enhance and expand the existing network by including more teachers and administrators and by equipping them with the tools and infrastructure they will need to effect long term sustainable technology-based educational reform.

The NM Technology Innovation Challenge Grant (TICG)/RETA Program will focus efforts in the following areas:

—Professional development of preservice and inservice teachers
—Advocacy development of administrators and policy makers
—Development of Regional Resource Centers at institutions of higher education
—Curriculum development and dissemination on the web (http://reta.mnsu.edu and
—Sustainability.

The RETA model is designed for adaptability and each training module is always tailored to the needs of the participants. Teachers participating in the professional development workshops benefit from a series of six sessions that allow them to begin at their own skill level and progress over the course of the academic year. RETA instructors work in pairs to deliver the workshops thus providing additional individual attention for groups that have mixed skills (which is always the case). The model is economical and can be scaled easily.

RETA instructors are practicing educators who help identify new instructors from a current pool of candidates who have recently completed the RETA instructional sessions. By developing teachers to become RETA instructors and building teams of teachers within districts who share the knowledge and skills to integrate technology to support educational goals, RETA is developing the capacity of New Mexico schools and districts to maintain their understanding of learning technologies.

RETA focuses on the development and leadership needed in schools to take full advantage of the technological infrastructures that are both present and planned.

Results to date have indicated that RETA is adding significant value and is well recognized for the quality of its learning experiences.

The program evaluation findings to date indicate that RETA has met and in many cases exceeded expectations by providing a core team of peer educators skilled in providing technology integration workshops for classroom teachers statewide; a statewide network of peers capable of providing continuing support; a statewide network of educators to assist with technology planning and implementation; peer workshops on how to integrate technology to support educational goals; exemplary curriculum models adaptable for K- 12 classroom application; administrative leadership in educational technologies and professional development; and communities of learning where skilled educators share their knowledge to promote student learning.

The Center for Children and Technology (CCT) will function as the outside evaluators for this project. CCT has extensive experience in research and evaluation of technology integration efforts. They will incorporate multiple methods of data collection in order to evaluate the NM TICG/RETA Initiative. A full annual report will be prepared by CCT staff to aid in the overall development of the project as well as brief quarterly summary reports will be disseminated to inform all program staff of ongoing data collection and evaluation information.

Data collection methods will include: (1) annual on site interviews (during yearly summer institutes) to obtain pre, interim and post data from participant sample engaged in each of the program areas; (2) follow-up phone interviews with participants to address ongoing issues of implementation; (3) electronically distributed and collected survey data examining the use of technology and utilizing web-based survey software such as Decisive Survey; (4) site-based observations in conjunction with a core group of graduate students (and through co'.laboration with institutions of higher education) who will collect data and observe activities at Regional Resource Centers; (5) strategically timed focus groups to aid in assessing the development and refinement of the structure of each phase of the project as it impacts on student learning and teacher preparedness to incorporate technology into classroom practice; (6) collection and analysis of participants' online communications taking place within the project's website throughout the project; and (7) the effects of these processes on student attitudes.

Impact of RETA

RETA achievements have not gone unnoticed. RETA was selected by the Council for Chief State School Officers (CCSSO) as one of three outstanding national projects for teachers' professional development. A presentation was given at the annual CCSSO Institute in Oakbrook, IL. RETA has also been selected for presentations at the International Conference on Technology in Education, the National Educational Computing Conference, and the Society for Information Technology and Teacher Education.

New Mexico has made incredible progress since 1995 in developing the hardware infrastructure. The state has invested $17 million and we are estimating that local communities have come up with $50 million to develop the technical infrastructure in the local districts. The RETA professional development initiative has helped to address the "capacity building" in the state by providing a platform to seriously address curriculum and policy issues. Over the past three years RETA has provided professional development opportunities in all but 5 of New Mexico's 89 school districts. (See attached map).

Now the emphasis has begun to shift from building the hardware infrastructure to a serious focus on student learning—which matches the State Technology Goal I (revised in 1999)significantly improve learning, leading to high achievement in challenging content standards through the use of information and communications technologies. While some may argue that the two should proceed in chorus (and I agree that they should in a perfect world), putting money into professional development to integrate technology that is not readily available to classroom teachers and their students is not a great investment over time.

With the TICG funding RETA has scaled efforts to match the developing hardware infrastructure to the benefit of the state and the learner. This also matches the State Technology Goal 2—Support ongoing professional development for integrating technology into the learning process. More and more teachers have received training; the leadership academy to address emerging policy, design, and evaluation issues; curriculum training modules available on the WWW, and the Regional Resource Centers are all mechanisms for on-going support beyond face-to-face training.

RETA is a carefully coordinated gram that understands technology is a powerful tool to significantly impact learning environments, however, for teachers and students to fully benefit from these improved environments, certain elements and conditions need to be existent. Namely, a human infrastructure that consists of skilled teachers, informed leaders, on-going professional development opportunities and responsive local networks all supported by effective curriculum models and an adequate and reliable technical infrastructure. RETA focuses on building the human infrastructure; a statewide network of educators who are capable of sustaining high quality technology—enhanced instruction and sharing that knowledge with peers.

RETA is guided by a shared vision where teachers understand how to use technology tools to enhance sound curriculum and engage students in authentic learning experiences that contribute to increased understanding, more advanced skills and more successful collaborative interactions. Teachers participating in RETA have sustained opportunities for reflection and practice, working together with peers in supportive environments where they can try out new applications. The workshop modules are designed for translation allowing the teachers to adapt the templates to meet their specific student needs. The RETA model helps develop networks where teachers (who often are isolated in their classrooms and schools) benefit from the renewal of interacting with colleagues sharing common. interests.

RETA has been guided by clearly articulated needs from a variety of stakeholders and these needs are clearly outlined in the state technology plan. However, with the wise investment of local, state, and federal dollars, students and their teachers are turning traditional learning environments into engaged learning environments. Some examples I would like to cite:

Margaret Hoskins third grade students are participating in a US WEST Learning Circle where they exchange KEYPAL email with classes all over the United States. They are working on a community project to create a state by state comparison chart with their pals. Ms. Hoskins was recently awarded a Christa McAuliffe Fellowship grant, on a project she calls: "CyberTechs Community School and Technology Training Pilot Program." The projects focus on training high school students to work as technology assistants, or CyberTechs, in a local elementary school.

Andy Newbre, from St. Michaels High School in Santa Fe, is using multimedia software to help high school students' author their own content software, which will serve as a peer tutorial for their quarterfinals review.

After attending a RETA workshop on developing WebQuests (an inquiry based approach to using the Internet), Shawna Smith, from Moriarty, wrote a Math/Science/PE/Technology Lesson Plan and entered it in the NSTA/Toshiba Laptop Learning Challenge and it won. She had the opportunity to attend the NSTA Convention in Boston.

Gina Chavez, from Chamiza Elementary in Albuquerque, is using spreadsheets and databases in her kindergarten classroom. Her students have taken Virtual Internet Tours of the National Gallery of Portraits, and the Georgia O'Keefe Museum, in Santa Fe. Ms. Chavez has coined the acronym, PSP, to describe her use of technology in the classroom. It stands for her suggestion to use Technology for Planning, Students, and Publishing.

While there are many stories to share about RETA, I would like to mention the impact RETA has had on the state's Technology Literacy Challenge Grants awarded to districts for technology funding. At least 75% of the districts with successful grant proposals are those that have been initiated and written by participants from RETA. When they return from the RETA workshops they become aware of their district's need for more technology and have taken the initiative to write the proposals.

I would like to close my testimony with a quote from one of the RETA participants, " I just need more, much more and so do others who could not attend the RETA workshops. . . . There is so much to learn and share. We just need more instruction—more opportunities to share—and more time to teach what we are learning."

On a personal note, I would especially like to thank you Senator Bingaman for your leadership in federal educational technology programs. Your 1994 legislation, the Technology for Education Act, was the first major source of dedicated federal funding for education technology. Since its introduction, educational technology programs have grown substantially nation wide. They are a major cornerstone to education reform efforts, teacher quality initiatives, and drop-out prevention programs. I encourage the Congress to continue and augment its support of educational technology for the betterment of America's schools.

The CHAIRMAN. Thank you, Doctor.

Thank you all. I am going to ask some general questions here but I want to start with Dr. Gonzales.

It seems as though you have a pretty well outlined program for the State, with development, evaluation and replication. What is your expectation for total replication?

Ms. GONZALES. For total replication? You mean within our State or elsewhere?

The CHAIRMAN. Within your State.

Ms. GONZALES. Well, by the time this initiative is over, 5 years if it has continued funding for 5 years, we anticipate that there will be enough people in each district that can carry on the professional development within their own districts.

The CHAIRMAN. So you think in 5 years you will have total replication?

Ms. GONZALES. Yes. And there is a lot of information on the Web available for anybody that wants to do that. Yes, I think that we will have that.

The CHAIRMAN. Well, that is very encouraging.

Ms. GONZALES. Well, we are a large State but we are not that big as far as population goes.

The CHAIRMAN. Does anyone else want to give me any information as to when you anticipate all your programs will be everywhere?

Mr. PITROFF. I am not as optimistic for the Baltimore City Public Schools in terms of replicating what we need from a technology perspective. Part of where I see us going, just to get our schools wired with the appropriate infrastructure in place at the level of funding and support that I am getting to make that happen, that will be the year 2017 before I have the data wiring in place, not anything programmatic but just the infrastructure that is needed.

So I am really hoping that there is going to be some support and some initiatives that are going to come down to help us really see this happen. Certainly every one of our schools has Internet access, but that is a point of contact. That is not fully prepared.

Ms. GONZALES. May I clarify my answer? I do not think that 100 percent of the teachers will be trained in technology use, but every district will have a critical mass of teachers that are using technology effectively.

The CHAIRMAN. Dr. Miller, any comments?

Ms. MILLER. I think that scalability is one of the most difficult problems that we face in all of educational projects and all of educational funding. I do not know the answer to it.

The CHAIRMAN. I see such great opportunity and fantastic ability to make a leap forward in education, but then I just wonder how long it is going to take us to do what we know we ought to do.

This is a related question. I am interested in what higher education is doing with teacher professional development, both for new teachers, as well as professional development or in-service. And I went through with a dozen college curricula and I only found mention of technology in one. I think that was somewhere in East Texas.

I wonder what your experience is, if you have any, with working with higher ed colleges, teacher colleges, to find out whether they are really getting into technology as an option or whether it is kind of ignored.

Ms. MILLER. There has been a woeful inadequacy in America's schools of education and in higher education in general. I mean, they have been far beyond the average third grade in terms of acceptance of technology. And unfortunately, the more prestigious the institution, the less willing has been the faculty itself to accept technology. People teach the way they are taught and most faculty, up to this point in time, I think have been very hesitant.

However, right now the growth of distance learning is nothing short of phenomenal. Higher education everywhere is looking at distance learning opportunities, particularly as private industry has been charging in there and doing competition.

We at JASON now are working increasingly with colleges of education across the country in terms of implementing multiple technologies in the classroom.

The CHAIRMAN. Those seem to be two contrary statements.

Ms. MILLER. They are two contrary statements, because up until this point in time there has been enormous hesitancy. I think the momentum has finally started and it is programs such as the ones you have seen on this panel that are really being the impetus for colleges. I mean they have to come on the bandwagon.

And there is going to be an enormous turnover of teachers in this country within the next 5 years and unless they come out trained and unless superintendents and principals demand teachers to be hired must be trained in technology, I mean it is a matter of the whole system systemically beginning to work.

Mr. DUGGAN. Senator, let me say a word about what is possible for educational institutions, once they tap into available technology. We have a service at PBS called the PBS Adult Learning Service. It is not seen on the home screen. People generally do not know about it and what it does, but it beams distance learning telecourses to two-thirds of the college and university campuses in America. It takes, for example, a Ken Burns historic documentary, "The Civil War," reversions it as a history course to be used in the hands as a tool for talented teachers.

Building on that, we have created with between 100 and 200 junior colleges, community colleges around the country, a service called Going the Distance, which enables off-campus students to take the two-year associate arts degree completely through distance learning telecourses. They can enroll in the local community college but they never have to visit the campus. They take the courses by downloading them to a VCR. They use the Internet to talk to the professor by e-mail, visit the library, take the tests, submit the term paper.

Last June we graduated the first degree candidate in the Going the Distance program. She was at a campus in Flint, Michigan. When she went to get her diploma, her two-year associate arts degree, it was the first time she had ever set foot on the campus. She had received her degree totally through the use of distance learning telecourses from the PBS Going the Distance program.

This really has the potential to enable every campus in America to enlarge its student body, to enlarge its effective area of impact without spending one dollar building classrooms, dormitories. It is a phenomenally efficient way to deliver education and we hope that other institutions of higher learning will tap into this.

The CHAIRMAN. Well, is that an answer, then, to the dilemma of the teacher colleges having no one apparently that is teaching technology, that they just tap into your program and they do not need any——

Mr. DUGGAN. Well, no, I do not think so. It is just one instrument that is available.

I think there is a danger in trying to interest people just in technology and infrastructure. I worry a little bit, for example, when the president and vice president have emphasized wiring the schools. Wires are wonderful, waves are wonderful, cyberspace, equipment—these things are wonderful, but content is the most important thing.

The CHAIRMAN. Absolutely.

Mr. DUGGAN. I think we need to organize our technology efforts around content. What is it that we want to convey? What is it that we want to teach? What are the ideas and skills that we want to transmit? Once we know that, we can arrange the infrastructure and the technology to do what we want to accomplish.

The CHAIRMAN. Well, that gets back to my original question that I was asking earlier. How do we know what works? How are we evaluating and what kind of structure should we set up for evaluation so that there is some confidence in evaluation, so that we can replicate? Any thoughts?

Mr. HOGAN. Senator, when I heard you ask that question before, the thing about how unique technology is is that if today we said there is no new technology, we just stopped, there is nobody in this room that could ever learn everything there is to know in their lifetime.

And I think the problem is that in education, we are doing a lot of things with technology and we do not test those things. In other words, if I have a student go out and do a research project, they go to the Internet, they go to CD-ROMs, they e-mail people, they synthesize this information. It is all great things, it is things we want, but there are no standardized tests to really test that.

So that is obviously one of the problems, that there really is nothing out there that tests a lot of the things that are being done with technology. There are a lot of tests that test skills. You know, we have seen outputs that people that use technology do better in math, they do better in science, and so on. But a lot of things that are coming out of here really are not things we test.

Ms. MILLER. I would like to comment on that. Because it is difficult, because we cannot measure with a multiple choice or a fill in the blank kind of test, instead, much of educational research has reverted to, "Well, they loved it," and that is not adequate. Qualitative testing is wonderful but we need longitudinal studies. We need to be able to demonstrate not just that people have acquired skills, as was so wonderfully explained in one of the projects here today, the work project, but we need to be able to look at what a person can do over time.

I mean in medicine, the Framingham Heart Study is known throughout the world because it has gone on for many years and each year we find things new in terms of human biology and in terms of influencing what is happening in the medical community.

We need a parallel to the Framingham Heart Study. We need to see how students, how people learn over time, and we have never had either the luxury or the resources in the education community ever to be able to do that.

Ms. GONZALES. I think in order to see change you really need to have at least 5 years to be able to see that change. And if you have an environment where kids are in a rich technology environment for 5 years with teachers who understand how to use it in a meaningful way, you could probably get some very good data.

The problem is most places do not have that. I mean I know in our State we cannot guarantee that a child will start in kindergarten and will have access to technology in every classroom, will have a teacher who understands how to integrate it meaningfully into their curriculum, and so on.

So that is a further complication to where we are at today. In maybe 10 years that will not be a problem because all the kids, the 14- and 15-year-olds will be teachers; they will integrate it naturally into their teaching, and technology will be everywhere. But right now I think that has been one of our problems as far as giving you meaningful data that shows numbers and how students are achieving and so forth.

The CHAIRMAN. Well, the thought of waiting 10 years for full implementation, because then we know they work is——

Mr. PITROFF. And Mr. Hogan's identification of assessment, unless we build performances with technologies within our assessment programs, we are going to have a very hard time selling anything to our schools. It was very difficult for us bringing innovative technology challenges to schools when the schools said, "Well, this is great but you are going to assess me on reading, writing and arithmetic." We need to develop new assessment tools and we need to support the schools to help them address that.

What I am seeing is happening in our new high school performance assessments that the State is dealing with, there are no technology integration pieces in it at all, so it is giving us another gap of years. I do not know how many years it is going to be before they begin to build it.

As an anecdote, when the State initiated our first testing program for all of our schools, they infused a calculator into the program in terms of the students needed to perform various tasks and performances with a calculator. All of a sudden we got calculators in all of our schools. So it was a direct impact.

I have been politicking with the State for years to get them to do that, so that we can look toward performance assessments through the use of innovative technologies.

The CHAIRMAN. But in Baltimore I know you have had, at least in the drop-out programs, you had been using technology in connection with the University of Chicago or somebody out there for 20 years.

Mr. PITROFF. Yes.

The CHAIRMAN. And I had my daughter involved in learning algebra and she took right off, having had a difficult time. That was 20 years ago.

So it is frustrating to see how we can move on quicker. That is the biggest issue that I have that I am looking at right now—what do we do in the ESEA to try to set up the structure to get us to move ahead, at least in an organized way so that we can have some hope of getting these things much quicker.

Any suggestions?

Ms. MILLER. You do not do it by bundling every piece of technology legislation into one mass and then give it out in terms of block grants to cities and towns because then it is spent on other things than the kinds of things you are trying to reinforce.

Mr. PITROFF. And what we do need to do is to bundle solutions, not pieces of solutions but the entire packet—the staff development support, the personnel support, the technology support, the content support, the programmatic support that is needed in replicating programs throughout systems, as well as other schools.

The CHAIRMAN. Is it capable of taking a school now, making it into a model? You said let's have a modern model now.

Mr. PITROFF. I think we are ready to begin to do that.

Ms. GONZALES. And I believe there are probably some schools out there and there actually is some longitudinal research through the ACOT studies, the Apple Classrooms of Tomorrow, where they did have rich technology environments and professional development for staff that you can look at. It is not the ordinary classroom that you will find in the ordinary school.

The CHAIRMAN. Would you agree that our teacher colleges should be trying to get ahead of this curve and implementing at least some meaningful courses in that direction?

Ms. GONZALES. What we have in our State, we have one course as an undergraduate that you are required to take, and that is it. At our institution we are working with the methods faculty to start integrating technology into their methods courses so that they will see technology integrated in the content areas before they leave the colleges of education and go into the classroom. But it is an area that needs a lot of work.

Mr. PITROFF. Both of our institutional partners, the University of Maryland at College Park and the Johns Hopkins University Center for Technology in Education, offer formal technology application courses to our teachers. One of the biggest changes that has been made is they do not offer it at their campuses. They come to where the teachers are and they are doing it through Web-based enabled applications, distance learning technologies, as well as providing staff development right at the school sites for our teachers.

So both of those institutions do have technology-integrated types of courses that our teachers can either get a formal degree through or a certification or credential that we are offering and sanctioning to each of our teachers.

Ms. MILLER. I think you offer incentives. You have incentives for kinds of partnerships that PBS is talking about, that various organizations here, whether ours or anyone else, that this technology spreads through content kinds of situations.

I mean just for a school to add five technology courses is not going to give the third grade teacher who is teaching math or the tenth grade teacher who is teaching science or history an opportunity unless there is an incentive for that college or that university to combine with historians, to combine with technology people, to look at PBS and look at the kinds of things that they are doing in allowing people to use technology to learn about Frank Lloyd Wright, about mathematics, about science, about the workplace.

Mr. HOGAN. Senator, in Ohio, Senator DeWine indicated before they have had the SchoolNet initiative, which basically wired the buildings, the school buildings and then what they called SchoolNet Plus, which started putting computers into K through 4 classrooms.

But another part of this has been staff development, where they have identified what they call novice tools and the education schools in Ohio are guaranteeing us that their teachers coming out have mastered those novice tools.

But again I would say if you want your bang for your buck, preservice education is a good place to put the money because it is going to go a long way. What Dr. Miller said before, we are going to see a big turnover of educators in the next few years and it is a lot easier to work with new people than some people who have been in the classroom for a number of years.

The CHAIRMAN. Well, thank you all. Unfortunately, time moves on, an hour longer than I had anticipated. But it has been very, very helpful testimony and this is an area that I think we have to really try to develop something to help in the ESEA reauthorization, to see what we can do to try to move things along more rapidly.

It has been exciting in many respects and I deeply appreciate all your work and if you do not mind, we may bug you for a few more answers as we move along, keeping bugs in mind.

[Whereupon, at 1:00 p.m., the committee was adjourned.]

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